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How Is the Liquidity and Volatility Affected by Implementing Round Lot One? Evidence from the Stockholm Stock Exchange

Hampus Frisén[φ]

Jacob Langhard Lövstedt[π]

Abstract
This paper studies how the round lot one implementation at the Stockholm Stock Exchange on Oct 13, 2008 impacted market liquidity and volatility. The impact is examined during a study period of 180 trading days using data from 223 treated stocks and 115 control stocks. Empirical results show that liquidity improves with statistical significance as explained by narrower relative bid-ask spreads and increased trading volumes. Absolute bid-ask spreads and trading turnover lack statistical significance but signals of an improvement in liquidity. Volatility is found to increase as explained by increased high-low spreads and 5-day and 10-day standard deviations. The findings for liquidity are consistent with prior research on the topic although volatility findings contradict with more recent studies.

Keywords: Round lot one, minimum trading units, liquidity, volatility, market microstructure

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[φ] 21941@student.hhs.se
[π] 21958@student.hhs.se

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I. Introduction

Over a number of years the Nordic exchanges have been striving towards similar market microstructures as a majority of the global trading exchanges. In 2005, the Omx Nordic Exchange/Nasdaq Omx[1] (hereafter referred to "Nasdaq Omx") started to investigate the possibility of a round lot one implementation[2] on the Nordic exchanges by asking its cash market members of their opinions. In 2006, Nasdaq Omx decided to implement round lot one on the Helsinki Stock Exchange ("HSE") and remove the odd lot order book. Since there were good implications following the round lot one implementation on the HSE, talks were initiated regarding a possible implementation of this practice on the Stockholm Stock Exchange ("SSE"). In addition to harmonizing and aligning its own exchanges, Nasdaq Omx hoped that by implementing round lot one on the SSE on Oct 13, 2008 the exchange would realize the same increase in liquidity and improvement in market access as had been experienced on the HSE. The implementation of round lot one on the SSE meant a move to a significantly smaller round lot size of one share and a removal of the odd lot order book precisely as done on the HSE (both the implementation and subsequent removal is hereafter referred to as "the reform" or "the round lot one implementation").

The effects that follow reductions in minimum trading units[3] ("MTU") have previously been under study. The first to examine these reductions were Amihud et al. (1999) who investigated the impact using data from the Tokyo Stock Exchange. Their study found that after a reduction in MTUs the investor base increases along with stock prices. This finding corresponds with latter studies using data from the Tel-Aviv Stock Exchange by Hauser and Lauterbach (2003), Tokyo Stock Exchange by Ahn et al. (2005), Borsa Italiana by Perotti et al. (2011) and Tokyo Stock Exchange by Isaka and Yoshikawa (2012). As well as verifying the proposed increase in the investor base, the studies extend previous findings by indicating that in general liquidity tends to increase while the effects on volatility are inconclusive (with earlier studies showing an increase in volatility and latter studies showing a decrease).

The purposes of this paper are to examine the round lot one implementation's effects on liquidity as well as add to prior research and further examine the effect on volatility. The study covers a study period of 180 trading days, equally divided around the reform date, and relies on daily quoted data for 223 stocks listed on the SSE and 115 stocks on the HSE. The SSE stocks are affected by reform and constitute the treated stocks, the HSE stocks are unaffected by the reform and constitute the control stocks. The reform's effect has been estimated using non-parametric tests and difference-in-differences estimations running clustered standard errors.

Our findings indicate that the reform has had a statistically significant positive effect on liquidity as explained by narrower relative bid-ask spreads and increased trading volumes. Absolute bid-ask spreads and trading turnover lack statistical significance but signals of an improvement in liquidity. We also find statistically significant results of an increased volatility as verified by increased high-low spreads and 5-day and 10-day standard deviations of logarithmic returns. The

[1] The name was changed to Nasdaq Omx in 2007/2008 after Nasdaq acquired Omx Nordic Exchange.
[2] The definitions of round and odd lots as well as round and odd lot order books are further developed and presented in Background on the Reform on page 4.
[3] Round lot sizes are in previous research referred to as minimum trading units.

findings for liquidity are consistent with prior research on the topic although volatility findings contradict with more recent studies. Our findings are partially robust when repeating the difference-in-differences estimations using another group of control stocks,[4] altering the study period, excluding stocks with missing observations and dividing into subgroups based on market capitalizations classes (small, mid and large cap).

II. Background on the Reform

Round Lot and Odd Lot Trading

Prior the reform, the SSE had a round lot unit size requiring all submitted stock trade orders to exceed a target value (i.e. a minimum size in terms of monetary value). The stocks on the SSE were traded in different lots: round lots[5] and odd lots. The target value for round lots was approximately 20,000 SEK for large cap stocks and 10,000 SEK for small and mid cap stocks.[6] The number of shares that constituted a round lot was subsequently dependent on the stock's current trading price while the number of shares that could not fulfill the round lot size constituted an odd lot. The value of a stock's round lot size was revised semiannually and adjusted if the value exceeded 100 percent or was lower than 50 percent of the target value. This trading requirement implied that an investor had to invest a minimum amount of 10,000-20,000 SEK in every stock held. The stock trading on the SSE was organized in two individual trading systems with separate trading rules: the round lot order book and the odd lot order book.[7]

Table I. Example of Round and Odd Lot Trading

The table presents an example illustrating how the trade execution differs between the round lot order book and the odd lot order book depending on the number of shares in a transaction. The transactions are identical apart for the number of shares. The round lot size is assumed to be 200 shares. The number of shares that is not equally divisible by the round lot size results in an odd lot.

	# of Traded Shares	# of Round Lots	# of Shares Traded Through the Round Lot Order Book	# of Odd Lots	# of Shares Traded Through the Odd Lot Order Book
Transaction #1	2,000	10	2,000	0	0
Transaction #2	2,075	10	2,000	1	75
Round Lot Size: 200 Shares					

In Table I the example assumes that two transactions are identical apart for the number of shares. In the first transaction, 2,000 shares are traded through the round lot order book in 10 batches of 200 shares (10 round lots). However, in the second transaction, 2,000 shares are traded through the round lot order book in 10 batches of 200 shares (10 round lots) while 75 shares are traded through the odd lot order book (one odd lot consisting of 75 shares).

Prior the reform investors had the opportunity to place odd lot orders through the odd lot order book. However, market making in the odd lot order book was inefficient. The odd lot order

[4] The control group consists of stocks listed on the Frankfurt Stock Exchange. The dataset is neither adjusted for a minimum of 30 valid trading days, stock splits, delistings, initial public offerings nor German Holidays.
[5] In Swedish referred to as "börsposter" or "handelsposter".
[6] At the time, the round lot size was 20,000 SEK for A-listed stocks and 10,000 SEK for O-listed stocks.
[7] In Swedish referred to as "stora orderboken" and "småorderboken" or "lilla orderboken" respectively.

book was very illiquid and few closes were made during trading days in comparison to the round lot order book. The illiquidity resulted from the fact that odd lot orders had to be matched against each other or combined into a full round lot, which could then be executed against the round lot order book. The matching algorithm used in the odd lot order book was found complicated by both traders and retail investors. As a result, pricing became less efficient and less competitive for the investors and orders took longer to execute. [8]

During the first six-month period of 2005 approximately 6.02 percent[9] of all stock trades were executed through the odd lot order book. For the second six-month period of 2007 the corresponding number were 9.68 percent whereas the trade value of odd lot trades, as a fraction of total trade value, was 0.41 percent. [10]

The Reform

On October 13, 2008 round lot one was implemented on the SSE, which had implications for the trading on the exchange. The reform meant a move to a considerably smaller round lot size of one trading unit and thereby revoked the old round lot system. As a result of the implementation, the odd lot order book ceased to exist and all trading was placed through the round lot order book. The reform was implemented because of Nasdaq Omx's will to further harmonize the Nordic and European exchanges, standardize its MTUs practices and align its rules and trading systems with the industry's best practice and foreign exchanges. In addition, Nasdaq Omx wanted to simplify its own IT-structure and hoped to attract more foreign cash market members of the exchange.[11] When Nasdaq Omx implemented round lot one on the HSE in 2006, the exchange experienced increased trading activity, trading turnover, liquidity in the order books and narrower bid-ask spreads. Thus, Nasdaq Omx hoped to achieve enhanced liquidity and improved market access for individual investors following the reform on the SSE.[12] Nasdaq Omx did not, however, mention the anticipated effects on volatility due to the reform. Over the past decade, major European stock exchanges have decided to implement round lot practices. For example, Euronext and Deutsche Börse implemented round lot one in 2000 and 2002 respectively while the London Stock Exchange has always had the practice. Similar to HSE, the implementation of round lot one at the Deutsche Börse resulted in decreased price spreads and increased liquidity. The decision to implement round lot one was made after discussions with exchange members and investors. Both groups showed strong support for the implementation.[13] The news regarding the reform was covered in the largest regional newspapers, and in their online sources, in several articles. Most articles gave information on how the reduction in MTU would facilitate trading for small investors. Media also reported extensively on the initial date of the reform as well as informed on the postponed and final implementation date. Thus, investors are assumed to have had considerable knowledge about the reform, the implementation date and the implications facing the smaller investors.

[8] As discussed in "Survey on Round Lots" (2005) by Norex.
[9] Ibid.
[10] Market data as given in "Round Lot One" (2008) by Nasdaq Omx.
[11] Private conversation with investment professional on April 24, 2012.
[12] As explained in "Newsletter October" (2008) by Nasdaq Omx.
[13] As discussed in "Implementation of Round Lot One at OMX Nordic Exchange Stockholm" (2008) by Nasdaq Omx.

Implications

Following the reform, investors became able to place trade orders for single shares and consequently to trade in amounts equal to a single stock's share price. This is be illustrated in Table II in which an investor is assumed to disregard the possibility of placing trade orders through the odd lot order book before the reform.

Table II. Example of Change in MTU

The table presents an example illustrating how the minimum number of shares required per stock trade is different before and after the reform. The stock is assumed to be a large cap stock with a trading price of 50 SEK and a round lot size of 400 shares (equal to a round lot value of 20,000 SEK). The investor is assumed to disregard the possibility of placing trade orders through the odd lot order book before the reform.

	Share Price (SEK)	Minimum Amount Required (SEK)	Minimum # of Shares Required
Before the Reform	50	20,000	400
After the Reform	50	50	1

The reform had positive implications for investors since it made asset allocation, diversification and order execution cheaper and easier for investors facing a capital constraint. The benefits of the reform from a smaller investor's point-of-view can be clearly understood by looking at the stock SSAB, whose round lot value amounted to approximately 50,000 SEK in 2005 after some bullish months. Still, prior to the reform investors could place their odd lot orders in ways other than through the odd lot order book. Institutions such as Aktiespararna and Aktieinvest offered their members to place trade orders once a month, which were then bundled and traded through the round lot order book. Consequently, the institutions helped smaller traders by trading in the round lot order book. However, trading through these institutions did not enable investors to trade whenever they wanted as trading was done on a monthly basis.

III. Prior Research

Research on this topic includes several studies on market microstructure-affecting subjects. The lion share of previous research on reductions in MTUs are unanimous in their findings and show that a reduction in MTUs have several effects for the liquidity, volatility and value of the affected companies' shares. The literature mostly related to this study has generally sought to examine the effects of a reduction in the MTU size by using the reduction as a natural experiment and focusing on validating Merton's (1987) proposition that an increase in a firm's investor base increases the firm's value. Merton (1987) stated that when more investors hold a stock, the stock becomes more available in terms of information and recognition, which increases stock value.

Following a reduction in MTUs, investors who prior to the reform had difficulties trading stocks due to capital constraints could suddenly enter the stock market. Moreover, investors who previously wanted portfolio diversification but could only achieve this through well-diversified stocks (such as investment companies) or mutual funds could suddenly diversify their holdings and achieve cheaper and more tailor-made diversification. This kind of improved trading access generally leads to an influx of smaller investors, which consequently increases firms' investor bases and stock prices (Amihud et al. (1999), Ahn et al. (2005), Isaka and Yoshikawa (2012)). In

addition, recent research points out that it is the composition of the investor base rather than the number of investors that determines the stock value (Ahn et al. (2005)). There is an established negative correlation between the number of stockholders and the stocks' bid-ask spreads (Benston and Hagerman (1974)). After reductions in MTUs, liquidity tends to increase as measured by increased trading volumes, improved liquidity ratio,[14] lower bid-ask spreads, lower price impact of orders and increased market depth as measured by the first five levels of the book (Amihud et al. (1999), Ahn et al. (2005), Perotti et al. (2011)). The findings correspond to research by Black (1986), which states that the more noise trading there is, the more liquid the market will be. The increase in noise trading can be explained by the influx of small investors since they are typically thought to be noise traders (Foucault et al. (2011)).

When markets become noisier they generally experience an increase in volatility as prices become less efficient (Black (1986)). Consequently, following an increase in the amount of smaller investors there should be an increase in volatility given established theory. Black's theory is backed by research indicating that after a reduction in MTUs the volatility typically increases (Hauser and Lauterbach (2003)). However, in contrast to earlier research and established theory, recent studies have found that volatility typically decreases (Perotti et al. (2011)) due to changed trading behavior (Ahn et al. (2005)). In general, informed traders trade more with noise traders than with other informed traders (Black (1986)). When the number of noise traders increase, informed traders have been proved to begin trading more aggressively (Kyle (1985), Ahn et al. (2005)). The increased aggressiveness causes private information to be revealed faster in prices and increases informational efficiency. As a result, prices become more informative and adjust more quickly to new information, which stabilize prices and reduce volatility. This is in contrast with the common belief that markets become noisier and prices less efficient when there are more noise traders in the market. The concept has been tested using the speed of adjustment of prices to full-information levels by Ahn et al. (2005).

There have been several studies covering research on the effects of changes in the market microstructure for stocks that are closely related to those covering changes in MTUs. Stock splits have similar effect on the investor base as reductions in MTUs (Mukherji et al. (1997)). Following stock splits, the ability to trade smaller units for investors has been found to improve liquidity (Amihud and Mendelson (1986, 1988), Muscarella and Vetsuypens (1996)) as well as increasing return volatility (Ohlson and Penman (1985)). However, stock splits are less ideal when examining what happens after an increase in the investor base. The price reductions affect minimum tick-sizes and thereby shift bid-ask spreads and return volatility. This problem is mitigated when studying changes in MTUs since the price level is unaffected (Ahn et al. (2005)). Similar to decreases in MTUs, tick-size reductions are another change in the market microstructure that leads to an influx of smaller investors and a larger investor base. Reductions in tick-sizes have positive effects on liquidity on the exchanges in which they are imposed. It has been found that reductions in tick-sizes lead to decreased bid-ask spreads as well as increased daily trading volumes (Harris (1994), Bacidore (1997), Goldstein and Kavajecz (2000)). Although, there is research stating that the trading volumes will remain unaffected (Bacidore (1997)). Stocks that have large market capitalizations and are heavily traded have shown significantly reduced

[14] The liquidity ratio is defined by Amihud et al. (1999) as $LR_i = \sum_t V_{it} / \sum_t |R_{it}|$ where V_{it} equals the trading volume for stock i on day t and R_{it} equals the return for stock i on day t.

bid-ask spreads following decreases in tick-sizes (Bessembinder (2003)). Furthermore, tick-size reductions have also had effects on the return volatility. However, these findings are contradictory since volatility has been found to decrease (Van Ness et al. (2000)) as well as increase (Bessembinder (2003), Ronen and Weaver (1998)).

IV. Theory and Hypotheses

This branch within finance research is called market microstructure. The studies within this topic are concerned with how exchanges occur in financial markets. The research normally studies the process and outcomes of exchanging assets under a specific set of rules in order to examine how the underlying mechanisms of trading affect the price formation process (more specifically how it affects prices, volumes, trading behaviors and trading costs among others) (O'Hara (1995)). To assess the impact on the change in market microstructure we study the reform's effect on liquidity and volatility similar to prior research.

Our study relies on past research within this topic, which state that the investor base increases as a result of the reform. The level of investor awareness prior to the reform and the media coverage that was received around the date of the reform strengthens this assumption. We do not make assumptions regarding the composition of the investor base, we only assume that the investor base increase following the reform. In prior research, investors were typically unable to place trade orders whose value were less than the value of the MTU size. This was on the SSE possible in theory, although in practice market making for these trades was poor and inefficient. Consequently, we expect our results to be similar to earlier research but probably of less magnitude.

Liquidity

Liquidity is generally described as the ability to trade large quantities at low cost with little price impact whenever the trader wants (Harris (2002), Liu (2006)). The definition is broad and there is no clear-cut measure for liquidity as some measures are more used and acknowledged in research than others. Thus, liquidity cannot be captured by a single simple measure but several must be used to assess the liquidity (Amihud (2002), Sarr and Lybek (2002)). Usually liquidity measures highlight four dimensions of liquidity; trading quantity, trading speed, trading cost and price impact (Liu (2006)). Consequently, in order to examine the reform's effect on market liquidity we will in this study use four measures: the quoted absolute and relative bid-ask spread as well as the daily trading volume and trading turnover. The study will neither use measures for the trading speed dimension nor the price impact dimension since we consider the four measures used in the study to capture market liquidity in a sufficient way.

The absolute and relative bid-ask spread are two measure for the trading cost dimension as seen in previous studies within liquidity (Amihud and Mendelson (1986a), Sarr and Lybek (2002)) and within this topic (Ahn et al. (2005), Perotti et al. (2011)). The trading cost dimension can be divided into explicit transaction costs (e.g. order processing costs and taxes associated with trading) and implicit transaction costs (e.g. asymmetric information costs). The bid-ask spread constitutes a good measure for both of these trading costs as it represents the trader's cost of

immediacy (Amihud and Mendelson (1986b), Harris (2002), Sarr and Lybek (2002)). A narrow bid-ask spread indicates lower trading costs and high liquidity whereas a large spread indicates higher trading costs and poor liquidity (Sarr and Lybek (2002)).

The trading volume and trading turnover captures the trading quantity dimension of liquidity as seen in previous studies within liquidity (Datar et al. (1998), Sarr and Lybek (2002)) and within this topic (Amihud (1999), Hauser and Lauterbach (2003), Ahn et al. (2005), Perotti et al. (2011)). The measures evaluate the degree of market participantion and transactions. High trading volumes and turnover indicate a more liquid market whereas low volumes and turnover indicate a less liquid market.

Prior research indicates that when the investor base increases, enhanced liquidity follows. This, in combination with earlier findings indicating that investor base increases following reductions in MTUs, enables us to state a hypothesis regarding the reform's effect on the liquidity.

Hypothesis I: The round lot implementation leads to an increased liquidity

Volatility

Volatility is the tendency for prices to change unexpectedly, which could be a result of new information or impatient traders (Harris (2002)). In order to examine the reform's effect on market volatility we will in this study use two measures: the relative spread between the daily high and low trading prices as well as the standard deviation of logarithmic daily returns using 5-day and 10-day averages. We use logarithmic returns in order to normalize variances and facilitate comparability (Sarr and Lybek (2002)).

The standard deviation is not always the best indicator of variability since it is based on daily closing prices and does not take into account fluctuations throughout the day. However, the use of standard deviation in combination with the relative high-low spread that captures the daily fluctuations gives us an enhanced measure of volatility, similar to previous research on daily stock market volatility by Turner and Weigel (1992).

Prior research and established theory indicate that following an increased investor base, volatility increases due the influx of smaller traders that are typically seen as noise traders. Despite later findings regarding the effect of reductions in MTUs on market volatility, this study assumes to achieve results mostly resembling those by Hauser and Lauterbach (2003) due to the use of similar data, parameters and working procedure. Decreased volatility as a result of changes in the trading behavior of informed traders as developed by Ahn et al. (2005) assumes that informed traders start trading more aggressively after the reform. We do not expect to see this change in trading behavior, as we believe it might be difficult to anticipate this in light of the market turbulences prevailing at the time. This enables us to state a hypothesis.

Hypothesis II: The round lot implementation leads to an increased volatility

V. Data

Treated and Control Stocks

The stocks are assigned to two groups based on its primary listing. Companies listed on the SSE are assigned to the treatment group while companies listed on the HSE are assigned to the control group. The treatment group consists of 223 companies and the control group consists of 115 companies.

The control stocks are traded on an exchange quite similar to the treated stocks, the only difference being that the control stocks experienced the same reform as the treated stocks several years earlier (2006). Both exchanges are governed by the same parent company (Nasdaq Omx), are close in terms of terms of culture and geographical location and should be subject to similar effects from macro-events and investor behaviors. Thus, the only difference between the two groups is considered to be the reform.

Data Description

The dataset consists of daily data for ask, bid, closing, high and low prices, market values, trading volumes and number of shares outstanding.[15] The dataset consists of 338 stocks, of which 223 stocks were listed on the SSE and 115 stocks were listed on the HSE. Of the 223 stocks listed on the SSE, 44 (20 percent) were listed on the large cap list, 71 (32 percent) were listed on the mid cap list and 108 (48 percent) were listed on the small cap list. Of the 115 stocks listed on the HSE, 24 (21 percent) were listed on the large cap list, 37 (32 percent) were listed on the mid cap list and 54 (47 percent) were listed on the small cap list.[16]

The study covers a time period of 180 trading days,[17] equally divided around the implementation date of round lot one on October 13, 2008. The study period is similar to estimation periods used in earlier research using the same type of data by Hauser and Lauterbach (2003). The study requires at least 30 valid trading days in each of the time periods in the estimation procedure in order to produce reliable parameters, consistent with previous research on the subject by Ahn et al. (2005). Some stocks might not have had 30 valid trading days due to lack of trading (a typical characteristic for very small and thinly traded stocks). Only companies that were listed on either of the exchanges during the entire study period are included in the study. The appropriate companies were found using the annually published Nordic List,[18] which is a complete list of all listed companies on the Nordic exchanges governed by Nasdaq Omx. Companies that had dual listings on both the SSE and HSE exchanges are only recorded for their primary listing. However, companies that had dual listings on other exchanges have been included since this is not assumed to affect the outcome of the reform. An example of a dually listed company that is only recorded in the treated stocks and not the control stocks is TeliaSonera AB since the company's primary listing is on the SSE. For companies that had multiple share classes only the

[15] The dataset was downloaded from Thomson Reuters Datastream on April 18, 2012.
[16] A complete list of the stocks included in this study and the division into treated and control stocks can be found in the Appendix.
[17] Trading days are adjusted for Swedish and Finnish holidays.
[18] The Nordic List was downloaded from Nasdaq Omx's webpage on April 18, 2012.

most traded share class (typically class B shares) has been included. Companies that exercised stock splits during the study period have been excluded since stock splits change the stock's microstructure, which might affect the results of the study. Stock prices have been adjusted for dividend payments and other capital distributions.

The dataset was winsorized on the one percent level in order to adjust for extreme observations, subsequently replacing the tail values below the first percentile with the value of the first percentile and vice versa for the values above the 99th percentile. Semiannually the stocks on the SSE and HSE are evaluated based on its market capitalization and labeled small cap, mid cap or big cap. The small cap listing requires a market capitalization of less than 150 MEUR, the mid cap listing requires between 150 MEUR and 1 billion euros and the large cap listing requires a market capitalization of above 1 billion euros. Due to lack of data regarding the labeling of stocks within the listings, the cap listings have been calculated manually for the stocks based on the announced methodology by Nasdaq Omx.[19]

Table III. Descriptive Statistics of Study Data for Treated Stocks

The table presents descriptive statistics of the mean, maximum, minimum, number of observations (N) and number of missing observations for the data of the treated stocks used in the study. The closing, ask, bid, high and low prices are expressed in SEK. The trading volume and shares outstanding are expressed in millions of shares. The market value is expressed in MSEK.

	Price Close	Price Ask	Price Bid	Price High	Price Low	Trading Volume	# Shares Outstanding	Market Value
Mean	51.61	51.90	51.18	53.66	51.45	681.81	157,205	1,090.2
Max	331.50	333.00	328.50	337.42	327.96	14,581.1	4,490,455	49,373
Min	0.79	0.8	0.77	0.78	0.73	0.1	471	0.8
N	40,140	40,138	40,139	38,151	38,151	38,143	40,140	40,140
Missing N	0	2	1	1,989	1,989	1,997	0	0

Table IV. Descriptive Statistics of Study Data for Control Stocks

The table presents descriptive statistics of the mean, maximum, minimum, number of observations (N) and number of missing observations for the data of the control stocks used in the study. The closing, ask, bid, high and low prices are expressed in SEK. The trading volume and shares outstanding are expressed in millions of shares. The market value is expressed in MSEK.

	Price Close	Price Ask	Price Bid	Price High	Price Low	Trading Volume	# Shares Outstanding	Market Value
Mean	71.53	72.10	70.84	73.53	70.64	546.10	136,055	1,328.2
Max	331.5	333	328.5	337.42	327.96	14,581.1	3,800,947	68,638.2
Min	0.79	0.8	0.77	0.78	0.73	0.1	2,167	2
N	20,700	20,692	20,692	19,193	19,193	19,194	20,700	20,700
Missing N	0	8	8	1,507	1,507	1,506	0	0

VI. Methodology

When examining liquidity, the absolute and relative bid-ask spread, daily trading volume and daily trading turnover is used. When examining volatility, the spread between daily high and low prices and the standard deviation of logarithmic daily returns are used. To examine the results of the reform, the study uses non-parametric tests and difference-in-differences regressions. The non-parametric tests constitute a before/after analysis and are used to explain whether the

[19] The stock listing is based on the average of the stock's market capitalization during May for the second period of the year and November for the first period of the year.

variables under study have been significantly changed during the time period. The difference-in-differences estimations are used to explain whether the reform has had an effect on the variables. The t-test used in the difference-in-differences estimations requires an assumption of normality in our sample. Despite our sample being large enough to assume normality,[20] we relax this normality assumption by comparing the results from the non-parametric tests with the results of the t-tests. Consequently, by using both the non-parametric tests as well as the difference-in-differences estimations the study achieves added robustness in the results.

Liquidity

The daily bid-ask spread is defined as the spread between the daily quoted highest bid and lowest ask price and is computed in both absolute and relative terms. The ask price represents the price at which a seller is willing to sell and the bid price represents the price at which a buyer is willing to buy.

$$Absolute\ Bid - Ask\ Spread = P_A - P_B$$

$$Relative\ Bid - Ask\ Spread = \frac{P_A - P_B}{(P_A + P_B)/2}$$

where P_A refers to the ask price and P_B refers to the bid price.

Liquidity is measured as the daily trading volume and defined as the aggregate number of traded shares during a day. The daily trading turnover is defined as the aggregate number of traded shares during a day divided by the total number of shares outstanding.

$$Trading\ Turnover = \frac{Daily\ \#\ of\ traded\ shares}{\#\ shares\ outstanding}$$

Volatility

Daily volatility is measured as the relative spread between the daily highest and lowest trading prices divided by the average of the two prices.

$$Relative\ High - Low\ Spread = \frac{P_H - P_L}{(P_H + P_L)/2}$$

where P_H refers to the high price and P_L refers to the low price.

Volatility is also measured as the standard deviation of the logarithmic daily return using daily closing prices. The volatility is calculated for two different periods (5-day[21] and 10-day) and then annualized for interpretable and comparable reasons. The study assumes 252 trading days in a year.

$$r_{t,i} = ln(p_{t,i}) - ln(p_{t-1,i})$$

where $p_{t,i}$ and $p_{t-1,i}$ refer to the price of stock i at time t and $t-1$, ln refers to the natural logarithm and $r_{t,i}$ refers to the return for stock i at time t.

[20] Further discussed in Difference-in-Differences Estimations on page 13.
[21] The 5-day volatility is usually referred to as the "weekly volatility".

$$Standard\ Deviation = \sqrt{\frac{\sum_{t=1,i}^{n}(r_{t,i} - \bar{r}_i)^2}{n-1}}$$

where $r_{t,i}$ refers to the close-to-close return of stock i at time t, $\bar{r}_i$ refers to the mean return for stock i over the period of n days, n refers to the number of days used in the calculation.

Wilcoxon Signed-Rank Tests: Before/After Analysis

The study uses a non-parametric Wilcoxon signed-rank test in order to test whether there is a significant difference in means for the studied parameters prior to and after the reform. The test only shows whether there is a significant difference in means or not around the reform and does not show whether the reform has led to the difference in means or not. The test is a distribution-free test and is complemented with the difference-in-differences estimations.

Difference-in-Differences Estimations

The two-sample t-test used in the difference-in-differences estimations is used to study the reform's effect on the studied parameters for the treated stocks in comparison with the control stocks. Because the number of observations is significantly above 25, the normality assumption that is required by the t-test can be considered to be satisfied.[22] The difference-in-differences estimations control for company fixed effects and use clustered standard errors on stock level to control for serial correlation in observations.

The model specification is

$$Y_{it} = \beta_0 + \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Treated_i * Post_t + a_i + \varepsilon_{it}$$

where Y_{it} is the dependent variable and represents any of the studied variables for stock i at time t, $Post_t$ is a dummy variable equal to 1 if the observation is on or after the reform date and 0 otherwise, $Treated_i$ is a dummy equal to 1 if the stock belongs to the treated stocks and 0 otherwise, $Treated_i * Post_t$ is a dummy equal to 1 if the observation belongs to the treated stocks and is on or after the reform date and 0 otherwise, β_3 is the difference-in-differences estimate, a_i is the stock fixed effects for stock i, ε_{it} is the error term.

VII. Empirical Results

The empirical results following the before/after analysis estimated using the non-parametric Wilcoxon signed-rank tests and the difference-in-differences estimations are presented and discussed below. The reform's effects on each of the studied variables are presented under the dimension that they explain. Complete regression results for the difference-in-differences estimations can be found in Table XIV in the Appendix. Graphs illustrating the difference in means as explained by the difference-in-differences estimations can be found in Graphs XV-XXI in the Appendix. Descriptive statistics of the dependent variables can be found in Tables X-XI in the Appendix. Graphs illustrating the appearance of the dependent variables can be found in Graphs I-XIV in the Appendix.

[22] When a sample with sample size A ≥ 25 the sample means will be approximately normally distributed according to the Central Limit Theorem, Newbold (2006).

Liquidity

The empirical results from our estimations indicate that the reform has had implications for the liquidity of the treated stocks. When analyzing the results of the liquidity variables we can conclude that all liquidity measures signals of an improved liquidity following the reform although there is only statistical significance for the reduction in relative bid-ask spreads and for the increase in trading turnover. Thus, we can see that the reform possibly has the expected effect in liquidity that we initially believed although we cannot with statistical significance accept the first hypothesis based on all four variables. Consequently, we cannot verify our first hypothesis. The regression results of the reform's effect on the liquidity for treated and control stocks can be found in Table V-VI.

Table V. Before/After Analysis of Liquidity Variables

The table presents the results of the before/after analysis for the liquidity variables. The table shows the means for the pre- and post-event periods around the reform. The change in means is expressed in absolute terms and the percentage change in means is expressed in relative terms. The stars indicate the p-value of the change where *p<0.1, **p<0.05 and ***p<0.01. The Z-value is obtained through a Wilcoxon signed-rank test where the mean in the pre-event window is tested against the mean in the post-event window. N corresponds to the number of observations in each event period. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points.

	Pre	Post	Change	Change (%)	Z-value	N (Pre)	N (Post)
Absolute Bid-Ask Spread							
Treated Stocks	0.802	0.625	-0.177***	-22.11%	32.65	20,069	20,069
Control Stocks	1.289	1.208	-0.081***	-6.28%	6.22	10,340	10,344
Relative Bid-Ask Spread							
Treated Stocks	1.984	2.246	0.263***	13.24%	-19.76	20,069	20,069
Control Stocks	2.578	3.115	0.538***	20.85%	-17.96	10,340	10,344
Trading Volume							
Treated Stocks	660.723	701.971	41.248***	6.24%	-19.89	18,643	19,500
Control Stocks	539.692	552.387	12.695***	2.35%	-6.84	9,510	9,684
Trading Turnover							
Treated Stocks	0.300	0.340	0.040***	13.26%	-18.48	18,643	19,500
Control Stocks	0.263	0.288	0.025***	9.35%	-7.01	9,510	9,684

Bid-Ask Spread

The before/after analysis of the absolute bid-ask spreads indicate that the spreads decrease with a statistical significance for treated stocks by approximately -0.18 SEK (corresponding to a relative percentage change of -22 percent) and for control stocks by approximately -0.08 SEK (corresponding to a relative percentage change of -6 percent). Thus, we can see that the decrease in absolute bid-ask spreads is greater for treated stocks than for control stocks (both in monetary and relative terms). The changes in each group are significant and the magnitude is due to both the reform and the time trend that affects both groups. Using the difference-in-differences estimation we can further explain the change in means and come to the conclusion that the difference-in-differences coefficient (representing the effect of the reform) explains

Table VI. Difference-in-Differences Estimations: Liquidity Variables

The table presents the results of the difference-in-differences estimations for the liquidity variables. The difference-in-differences estimator is given by Treated×Post, the time trend estimator is given by Post, the country specific estimator is given by Treated and the constant is given by Constant. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points.

	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover
Treated×Post	-0.0965	-0.2746**	48.8492*	0.0201
	[0.0609]	[0.1389]	[27.1717]	[0.0187]
Post	-0.0809	0.5372***	22.4527	0.0288**
	[0.0533]	[0.1288]	[15.3074]	[0.0117]
Treated	(omitted)	(omitted)	(omitted)	(omitted)
Constant	0.9676***	2.1858***	608.3378***	0.2841***
	[0.0133]	[0.0278]	[8.0609]	[0.0053]
N	60,822	60,822	57,337	57,337
R^2	0.004	0.007	0.002	0.002

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

approximately 0.1 SEK of the bid-ask spreads while -0.08 is due to the time trend. However, the latter result of the difference-in-differences estimation is not statistically significant as the difference-in-differences estimator receives a p-value of 11.4 percent.

The before/after analysis of the relative bid-ask spreads indicate that the spreads increase with a statistical significance for treated stocks by approximately +0.26 percentage points (corresponding to a relative percentage change of +13 percent) and for control stocks by approximately +0.54 percentage points (corresponding to a relative percentage change of +21 percent). Intuitively, these results contradict our earlier findings. However, we can see that the increase is bigger for control stocks indicating that the decreased relative bid-ask spreads that we had hoped for might have been offset by an increasing time trend. This difference between treated and control stocks should be a consequence of the reform. Examining the difference-in-differences estimation we can with statistical significance conclude that the reform has had a narrowing effect on the relative bid-ask spread. The difference-in-differences estimation indicates that the time trend increases relative bid-ask spreads by approximately +0.54 percentage points while the reform decreases the spreads by approximately -0.27 percentage points. Both findings are statistically significant and can together with the before/after analysis be seen as the true effect of the reform. The increase in the relative bid-ask spreads due to the time trend might be explained by the high volatility resulting from the market turmoil that prevailed during the study period.

The lack of significance in the absolute bid-ask spreads difference-in-differences estimation makes it difficult to draw the conclusion that the absolute spreads have decreased with certainty due to the reform. The results from the absolute bid-ask spreads estimation can consequently only be used as a hint of the reform's outcome. In contrast, we can with statistical significance

state that the relative bid-ask spreads have decreased due to the reform. Relying on the results of the absolute and relative bid-ask spreads we can partially state that the reform has created smaller spreads. Our results are in line with prior research on reductions in MTUs previously performed on other exchanges stating that bid-ask spreads always tend to decrease (Amihud et al. (1999), Ahn et al. (2005), Perotti et al. (2011)).

Trading Volume

The trading volumes increase by around +41 million shares (corresponding to a relative change of +6 percent) for treated stocks and by nearly +13 million shares (corresponding to a relative change of +2 percent) for the control stocks. The increase in trading volumes is statistically significant for both groups. When comparing the before/after analysis results we can see that there is a larger increase in trading volumes for treated stocks in both absolute and relative terms. This is a clear indication that the reform might have had a positive effect on trading volumes. The difference-in-differences estimation tells us whether the reform causes the increase in trading volumes for treated stocks or not. The difference-in-differences estimation explains an increase in trading volumes of approximately +22 million shares due to time trends and nearly +49 million shares due to the reform. The results are statistically significant and can subsequently be used as an outcome of the reform. Prior research states that reductions in MTUs have positive effects on the trading volume (Ahn et al. (2005)) and we can with statistical significance conclude that this is applicable for this reform. Thus, we can state that increased trading volumes are due to the reform.

Trading Turnover

The before/after analysis indicates that trading turnover increases for treated stocks by +0.04 percentage points (corresponding to a relative change of +13 percent) and for control stocks +0.03 percentage points (corresponding to a relative change of +9 percent). The increase is statistically significant for both groups. The difference-in-differences estimation indicates that trading turnover increases by +0.03 percentage points due to time trends, which indicates a statistically significant overall trend in trading turnover. This increase due to time trends might be explained by the current turbulences in the markets. The reform is shown to explain an increase in trading turnover of approximately +0.02 percentage points, although this increase is not statistically significant and can only be used as an indicator of the outcome of the reform. Treated stocks show a larger increase in trading turnover in comparison with the control stocks following the reform. This is in line with the results from the estimations of the trading volumes. The results in the difference-in-differences regression give the same indications and show that the reform is positively related to trading turnover. However, the lack of statistical significance requires us to use the results as an indication, despite our findings in the before/after analysis and the difference-in-differences estimation being consistent with previous studies and research. Thus, we cannot with statistical significance state that increased trading turnover is due to the reform.

Volatility

The empirical results from our estimations indicate that the reform has had implications for the volatility of the treated stocks. When analyzing the results of the volatility variables we can conclude that all volatility measures show with statistical significance that volatility increases following the reform. Consequently, we can accept our second hypothesis. The regression results of the reform's effect on the volatility for treated and control stocks can be found in Table VII-VIII.

Table VII. Before/After Analysis of Volatility Variables

The table presents the results of the before/after analysis for the volatility variables. The table shows the means for the pre- and post-event periods around the reform. The change in means is expressed in absolute terms and the percentage change in means is expressed in relative terms. The stars indicate the p-value of the change where *p<0.1, **p<0.05 and ***p<0.01. The Z-value is obtained through a Wilcoxon signed-rank test where the mean in the pre-event window is tested against the mean in the post-event window. N corresponds to the number of observations in each event period. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

	Pre	Post	Change	Change (%)	Z-value	N (Pre)	N (Post)
High-Low Spread							
Treated Stocks	3.843	5.640	1.798***	46.78%	-54.25	18,643	19,508
Control Stocks	3.805	4.827	1.022***	26.86%	-21.91	9,510	9,683
Standard Deviation (5-day)							
Treated Stocks	0.400	0.567	0.167***	41.69%	-48.15	20,070	20,070
Control Stocks	0.355	0.480	0.124***	35.02%	-31.78	10,350	10,350
Standard Deviation (10-day)							
Treated Stocks	0.395	0.551	0.156***	39.45%	-45.31	20,070	20,070
Control Stocks	0.329	0.448	0.119***	36.03%	-31.17	10,350	10,350

Table VIII. Difference-in-Differences Estimations: Volatility Variables

The table presents the results of the difference-in-differences estimations for the volatility variables. The difference-in-differences estimator is given by Treated×Post, the time trend estimator is given by Post, the country specific estimator is given by Treated and the constant is given by Constant. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	0.8083***	0.0424***	0.0371**
	[0.1471]	[0.0155]	[0.0168]
Post	1.0405***	0.1244***	0.1187***
	[0.1196]	[0.0116]	[0.0125]
Treated	(omitted)	(omitted)	(omitted)
Constant	3.8096***	0.3848***	0.3727***
	[0.0354]	[0.0039]	[0.0042]
N	57,344	60,840	60,840
R^2	0.055	0.045	0.044

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

High-Low Spread

The before/after analysis indicates that the high-low spreads increases with a statistical significance by +1.8 percentage points (corresponding to a relative change of +47 percent) for treated stocks and +1.0 percentage points (corresponding to a relative change of +27 percent) for control stocks. The before/after analysis indicate that the high-low spreads have increased more for treated stocks than for control stocks. Intuitively, one can see that the result is in line with our second hypothesis. The difference-in-differences estimation explains an increase by +0.81 percentage points due to the reform and +1.04 percentage points due to the time trends. The results following the difference-in-differences estimations are statistically significant. The increase due to time trends indicates that there is an overall trend in stock price fluctuations throughout the day. The increase in the high-low spreads aligns our results to previous research by Hauser and Lauterbach (2003), which concludes that volatility increases following a reduction in MTUs due to an increased investor base. Since our findings are statistically significant we can with certainty state that the high-low spreads increases due to the reform.

Standard Deviation (5-day and 10-day)

The 5-day standard deviation increases with a statistical significance by +16.7 percentage points (corresponding to a relative percentage change of +42 percent) for the treated stocks +12.4 percentage points (corresponding to a relative change of +35 percent). The difference-in-differences estimation explains an increase in the 5-day standard deviation of approximately +4.2 percentage points due to the reform and +12.4 percentage points due to time trends. The before/after analysis reveals that the 10-day standard deviation increases with a statistical significance by +15.6 percentage points (corresponding to a relative change of +39 percent) for treated stocks and by +11.9 percentage points (corresponding to a relative change of +36 percent) for control stocks. The difference-in-differences estimation explains an increase in the 10-day standard deviation of approximately +3.7 percentage points due to the reform and +11.9 percentage points due to time trends. The increase in time trends standard deviation corresponds well to the market turbulences. The before/after analysis shows that the results expressed as a change in both absolute and relative terms are larger for treated stocks than for control stocks. Examining the difference-in-differences estimations we see that the reform has with statistical significance had an increasing effect on the standard deviation irrespective of the use of the 5-day or 10-day measure. The findings are clear and statistically significant and we can with certainty conclude that the standard deviation increases due to the reform.

VIII. Discussion

This section aims to discuss our findings and possible caveats that should be reflected upon. We also perform several robustness checks to assess the validity of our results.

Results

Our findings are in line with prior research within the fields of market microstructure and especially within this topic. Following the reform when the investor base increases we would expect market liquidity and volatility to be affected in the same way as our results indicate. A consequence of the reform is an influx of smaller investors (noise traders). When noise trading

increases, markets generally become more liquid as found by Black (1986) and it becomes natural to anticipate that bid-ask spreads decreases and trading volumes and trading turnover increases as shown in our findings and earlier research by Amihud (1999), Hauser and Lauterbach (2003), Ahn et al. (2005), Perotti (2011). An increased investor base clearly affects the liquidity in a positive way. When the number of market participants increase the market becomes more active, which we can see in our liquidity variables. The tighter relative bid-ask spreads indicate that investors face lower costs of trading after the reform since the measure represents the trading cost dimension of liquidity. Following the improved liquidity, volatility also increases as shown in our results and in studies by Black (1986) and Hauser and Lauterbach (2003). From our findings we see that fluctuations throughout the day as well as close-to-close variations have increased, which is probably a direct effect of the increased number of smaller investors. However, volatility has been found to decrease in recent studies by Ahn et al. (2005), Perotti et al. (2011), which clearly contradicts with our findings. Ahn et al (2005) explain the decrease in volatility as a result of the behavior of informed traders. Evidently, informed traders start trading more aggressively when more noise traders enter the market, which results in more stable prices and a reduced volatility. An explanation for the lack of decrease in volatility in our findings may stem from the fact that the behavior of informed traders' did not change following the reform. This might be a result of the market turbulences that prevailed at the time of the study (as clearly shown in the time trend dummies in the difference-in-differences estimations for the liquidity and volatility variables), which might have prevented a change in the informed traders behavior. In light of our findings for liquidity and volatility we can see that there is clearly a tradeoff between having a liquid or volatile market. This is a tradeoff that should be contemplated when exchanges strive towards improved market access and more harmonized and similar market microstructures. Thus, our findings indicate that a reduction in the minimum monetary value needed for trading plays an important role for the investor base and subsequently the market's liquidity and volatility.

However, there might be several caveats that affect our results, some of which are mentioned and tested for in Robustness Checks[23] and some of which we cannot control for. First, during the study period, the global trading markets began to experience the turmoil of the financial crisis. Markets' different responses to global trends and crises usually depend on the level of correlation and integration between markets. How the SSE stocks are affected by the financial crisis in comparison with the HSE stocks is an obvious caveat. If the SSE stocks are more sensitive to an increased global volatility than the control stocks this will show in the estimation results. This could be tested for, although we have chosen not to do so because of the assumptions that we made regarding the characteristics of the control stocks. In addition, other aspects that may have affected the two groups differently during the study period are local trends (e.g. in trading behavior, interest rates) or changes in country-specific laws (that we are unaware of and that may have had either an indirect or direct effect on the stocks). Furthermore, the presumed increase in the investor base following the reform as clearly demonstrated in several earlier studies is perhaps not applicable for this reform (although, all studies within this topic points towards this increase). If we were to assume that the investor base does not develop in the same manner as found in prior research and that the SSE stocks are more influenced by global

[23] Page 20.

trends than control stocks, the results that we see might simply be the beginning of the financial crisis' country-specific effects on the SSE stocks. Moreover, Ahn et al. (2005) suggest that it is the composition of the investor base (the number of small investors relative to institutional investors) that affects the outcome of a reduction in MTUs. Having this in mind one could assume that the SSE already had the composition as explained in their study, which would make the reform's effect on the variables less significant. The level of investor participation on the SSE prior to the reform might also have already reached its maximum (leaving no room for an increased investor base), which could diminish the measurable effects of the reform. In addition, the trade flows that are generated by the influx of small investors may have been offset by the flows generated by large institutional investors, which may have diminished the measurable effects of the influx of small investors. Lastly, the illiquid and poor but still functioning odd lot order book that enabled investors to trade odd lots (despite inefficient market making), may also have had a diminishing influence on the measurable effects of the reform.

Robustness Checks

Our findings are subject to the choice of control stocks. If the SSE and HSE stocks have the same characteristics as we specified in Treated and Control Stocks[24] we would assume our results to be unbiased and show the true effects of the reform. Thus, to assess the robustness of our findings we repeat the difference-in-differences estimations by using another control group consisting of stocks listed on the Frankfurt Stock Exchange (the exchange is governed by Deutsche Borse and implemented round lot one in 2002). The control group includes 762 stocks and the dataset has not been adjusted for a minimum of 30 valid trading days, stock splits, delistings, initial public offerings and German holidays. The results are available in Table XV in the Appendix. The findings indicate that our results are robust for relative bid-ask spreads, trading volumes and high-low spreads, although statistically significant results cannot be found for standard deviation. The results also indicate that there is a statistically significant increase in absolute bid-ask spreads. Thus, by using another control group we can further isolate the effects of the reform and conclude that it affected liquidity and volatility through narrower relative bid-ask spreads, increased trading volumes and increased high-low spreads.

The study period used in this paper might not be long enough to rely on the assumption of an increased investor base following the reform. As a result of the very volatile global markets, investors might have chosen not to enter the market or have chosen to exit the market or simply not have had enough time to adapt to the possibilities that the reform entailed. This would effect the assumption we made. In order to test the robustness of the results we check whether the results are affected by the length of the study period around the reform date and repeat the difference-in-differences estimations using study periods of 160 and 200 trading days, equally divided around the event. The results are available in Table XVI-XVII in the Appendix. In general, our findings are robust to an extension of the event window to 200 days. When using 200 days, we see that absolute bid-ask spreads increase in statistical significance while 5-day standard deviation decreases. The liquidity coefficients are somewhat higher while the volatility coefficients are somewhat lower. When we shorten the event window to 160 days we can see that there is a loss in statistical significance for all liquidity variables while the volatility variables

[24] Page 10.

are still robust, although the coefficients for all variables are somewhat lower. This could indicate that the investors are gradually adapting to the reform and that the effects are best captured by a longer event window. However, this would make the isolation of the reform's effects more difficult.

The number of daily price observations differs for the treated and control stocks due to missing observations for infrequently traded stocks, which could bias our results. Despite having adjusted for this by excluding stocks that lack a minimum of 30 valid trading days in each estimation window similar to previous research by Hauser and Lauterbach (2003), the number of missing observations is still larger for the control stocks expressed as a fraction of the number of observations. As a robustness check we therefore repeat the difference-in-differences estimations using only stocks with non-missing observations. The results are available in Table XVIII in the Appendix. When we only include stocks with non-missing observations we can see that the statistical significance for the relative bid-ask spreads is lost while it is unchanged for the trading turnover. The coefficients for absolute and relative bid-ask spreads are considerable smaller while the opposite is true for trading volumes and trading turnover. Statistical significance is similar for the volatility variables, although the coefficients are larger. Thus, we can conclude that our findings for liquidity are still partially true and for volatility they are consistent.

The market size could constitute a source of explanation on how different stocks are affected by the reform. We have therefore repeated the difference-in-differences estimations using three subgroups based on the Nasdaq Omx market capitalization listings (small cap, mid cap, large cap) in order to assess our results. The small cap listing requires a market capitalization of less than 150 MEUR, the mid cap listing requires between 150 MEUR and 1 billion euros and the large cap listing requires a market capitalization of above 1 billion euros. An observation equals value 1 if the observation belongs to the subgroup.

The model is repeated and the specification is

$$y_{it} = \beta_0 + \beta_1 Event_{it} + \beta_2 Treatment_i + \beta_3 Treatment_i * Event_{it} + \beta_4 Small\ Cap + \beta_5 Mid\ Cap + \beta_6 Large\ Cap + a_i + \varepsilon_{it}$$

The results are available in Table XIX in the Appendix. In general, when sorting into subgroups based on the market capitalization listings we can see that the statistical significance of the variables is reduced. Looking at the small cap stocks, we can conclude that statistical significance is changed within the liquidity variables while it is decreased for the volatility variables. Mid cap stocks lose almost all significance and have only statistically significant results for the volatility variables. However, for large cap stocks statistical significance is intact for the volatility variables while shifted among the liquidity variables. Consequently, our results are partially robust when controlling for the market capitalization listings.

IX. Conclusion

The purposes of this paper were to examine the round lot one implementation's effects on liquidity as well as add to prior research and further examine the effects on volatility. Round lot one was implemented as a result of Nasdaq Omx's will to achieve greater liquidity and improve market access for individual investors. Nasdaq Omx did not mention anticipated implications on volatility. Positive effects on liquidity are expected if one relies on prior research within this subject and on experience gained from other exchanges (such as the HSE and Deutsche Börse), although the effects on volatility are inconclusive. Our findings indicate that the reform has had a statistically significant positive effect on liquidity as explained by narrower relative bid-ask spreads and increased trading volumes. Absolute bid-ask spreads and trading turnover lack statistical significance but signals of an improvement in liquidity. We also find statistically significant results of an increased volatility as verified by increased high-low spreads and 5-day and 10-day standard deviations of logarithmic returns. The increase in liquidity and volatility is presumably a consequence of the increased investor base that comes with the influx of smaller investors (noise traders) following the reform. When the investor base increases, we can see decreased relative bid-ask spreads and increased trading volumess, which we interpret as improved market liquidity. As a result of this improvement, we see an increased volatility as prices become less efficient. This finding is in contrast to recent studies that indicate that prices become more informative due to changes in the trading behavior of informed traders following reductions in MTUs. We interpret the increase in volatility on the SSE as a result of the informed traders' trading behavior, which does not develop in the same way as found in previous research. Our findings for liquidity and volatility show that there might be a tradeoff between having a liquid or volatile market. This tradeoff that could be contemplated when considering to implement round lot one. The empirical results indicate that a reduction in the minimum monetary value needed for trading plays an important role for the market's liquidity and volatility. Robustness checks show that our findings are partially robust when using another group of control stocks, altering the study period, excluding stocks with missing observations and dividing into subgroups based on market capitalization classes (small, mid and large cap).

References

Ahn, H., Cai, J., Hamao, Y., Melvin, M., (2005), "Little Guys, Liquidity, and the Informational Efficiency of Price: Evidence from the Tokyo Stock Exchange on the Effects of Small Investor Participation", Sungyunkwan University, working paper.

Amihud, Y., (2002), "Illiquidity and Stock Returns: Cross-Section and Time-Series Effects", Journal of Financial Markets Vol. 5, No. 1, pp. 31-56.

Amihud, Y., Mendelson, H., (1986a), "Asset Pricing and the Bid-Ask Spread", Journal of Financial Economics Vol. 17, No. 2, pp. 223-249.

Amihud, Y., Mendelson, H., (1986b), "Liquidity and Stock Returns", Financial Analysts Journal Vol. 42, No. 3, pp. 43-48.

Amihud, Y., Mendelson, H., Uno, J., (1999), "Number of Shareholders and Stock Prices: Evidence from Japan", The Journal of Finance Vol. 54, No. 3, pp. 1169-1184.

Bacidore, J.M., (1997), "The Impact of Decimalization on Market Quality: An Empirical Investigation of the Toronto Stock Exchange", Journal of Financial Intermediation Vol. 6, No. 2, pp. 92-120.

Benston, G.J., Hagerman, R.L., (1974), " Determinants of Bid-Ask Spreads in the Over-the-Counter Market", Journal of Financial Economics Vol. 1, No. 1, pp. 353-364.

Bessembinder, H., (2003), "Trade Execution Costs and Market Quality after Decimalization", The Journal of Financial and Quantitative Analysis Vol. 38, No. 4, pp. 747-777.

Black, F., (1986), "Noise", The Journal of Finance Vol. 41, No. 3, pp. 529-543.

Datar, V., Naik, N., Radcliffe, R., (1998), " Liquidity and Asset Returns: an Alternative Test", Journal of Financial Markets Vol. 1, No. 2, pp. 203-220.

Foucault, T., Sraer, D., Thesmar, D.J., (2011), "Individual Investors and Volatility", The Journal of Finance Vol. 66, No. 4, pp. 1369-1406.

Goldstein, M.A., Kavajecz, K.A., (2000), "Eighths, Sixteenths, and Market Depth: Changes in Tick Size and Liquidity Provision on the NYSE", Journal of Financial Economics 56, Vol. 1, pp. 125-149.

Harris, L., (2002), "Trading and Exchanges: Market Microstructure for Practitioners", Oxford University Press, draft copy.

Harris, L.E., (1994), "Minimum Price Variations, Discrete Bid-Ask Spreads, and Quotation Sizes", The Review of Financial Studies Vol. 7, No. 1, pp. 149-178.

Hauser, S., Lauterbach, B., (2003), "The Impact of Minimum Trading Units on Stock Value and Price Volatility", The Journal of Financial and Quantitative Analysis Vol. 38, No.3, pp. 575-589.

Isaka, N., Yoshikawa, H., (2012), "Stock Price Reactions Following Minimum Trading Unit Reductions and Stock Splits: Evidence from Japan", Sophia University, working paper.

Kyle, A.S., (1985), "Continuous Auctions and Insider Trading", Econometrica Vol. 53, No. 6, pp. 1315-1335.

Lui, W., (2006), "A Liquidity-Augmented Capital Asset Pricing Model", Journal of Financial Economics Vol. 82, No. 3, pp. 631-671.

Lybek, T., Sarr, A., (2002), "Measuring Liquidity in Financial Markets", IMF Monetary and Exchange Affairs Department, working paper.

Merton, R., (1987), "A Simple Model of Capital Market Equilibrium with Incomplete Information", The Journal of Finance Vol. 42, No. 3, pp. 483-510.

Mukheji, S., Kim, Y.H., Walker.M.C,, (1997), "The Effect of Stock Splits on the Ownership Structure of Firms", Journal of Corporate Finance Vol. 3, pp. 167-188.

Muscarella, C.J., Vetsuypens, M.R., (1996), "Stock Splits; Signaling or liquidity? The Case of ADR 'Solo-Splits'", Journal of Financial Economics Vol. 42, No. 1, pp. 3-26.

Newbold, P., Carlson, W.I., Thorne, B., (2010), "Statistics for Business and Economics", 7th Edition, Pearson Education Inc., pp. 274-280.

O'Hara, M., (1995), "Market Microstructure Theory", Cambridge Massachusetts, Blackwell Publishers.

Ohlson, J., Penman, S,. (2011), "Volatility Increases Subsequent to Stock Splits: an Empirical Aberration", Journal of Financial Economics Vol. 14, No. 2, pp. 251-266.

Perotti, P., Fredella, R., Rindi, B., (2011), "Minimum Trade Unit Regulation and Market Quality", University of Graz, Bocconi University, working paper.

Ronen, T., Weaver, D.G., (1998), "The Effect of Tick Size on Volatility, Trader Behavior, and Market Quality", Rutgers University, working paper.

Turner, A.L., Weigel, E.J., (1992), "Daily Stock Market Volatility: 1928-1989", Management Science Vol. 38, No. 11, pp. 1586-1609.

Van Ness, B.F., Van Ness, R.A., Pruitt, S.W., (2000), " The Impact of the Reduction in Tick Increments in Major U.S. Markets on Spreads, Depth, and Volatility", Review of Quantitative Finance and Accounting Vol. 15, No. 2, pp. 153- 167.

Databases

Thomson Reuters Datastream 5.1, (2012), [2012-04-18].

Internet

Nasdaq Omx, (2008), "Implementation of Round Lot One at OMX Nordic Exchange Stockholm", Available: [online] http://www.mynewsdesk.com/se/view/pressrelease/implementation-of-round-lot-one-at-omx-nordic-exchange-stockholm-223514 [2012-04-18].

Nasdaq Omx, (2008), "Newsletter October", Available: [online] http://www.nasdaqomx.com/digitalAssets/57/57208_081009_Newsletter__October_Eng.pdf [2012-04-18].

Nasdaq Omx, (2012), "The Nordic List", Available: [online] http://www.nasdaqomxnordic.com/digitalAssets/77/77417_thenordiclistjan22012.xls [2012-04-18].

Oslo Bors, (2005), "Survey on Round Lots", Available: [online] http://www.oslobors.no/ob_eng/Oslo-Boers/Regulations/Consultations/Survey-on-Round-Lots [2012-04-18].

Oslo Bors, (2008), "Round Lot One", Available: [online] http://www.oslobors.no/ob_eng/content/download/15342/464364/file/Consultation_Round_Lot_One.pdf [2012-04-18].

Appendix

Table X. Descriptive Statistics for Treated Stocks

The table presents descriptive statistics for the variables in the study before and after the reform for the treated stocks. The statistics is shown for both the winsorized and unwinsorized data.

		Winsorized		Unwinsorized	
Parameter	**Descriptive statistic**	**Before**	**After**	**Before**	**After**
Absolute Bid-Ask Spread	Mean	0.8022	0.6249	0.7593	0.6135
	Median	0.45	0.30	0.45	0.30
	Max	23.26	30	23.26	30
	Min	0	-2.75	0	-2.75
	StdDev	1.1325	0.9123	1.0495	0.8881
	StdErr	0.0080	0.0064	0.0074	0.0063
	N	20,069	20,069	20,069	20,069
Relative Bid-Ask Spread	Mean	1.9837	2.2464	1.9709	2.2438
	Median	1.2048	1.3304	1.1561	1.3130
	Max	60.3550	57.2391	60.3550	57.2391
	Min	0	-12.7473	0	-12.7473
	StdDev	2.6498	2.8088	2.6709	2.8283
	StdErr	0.0187	0.0198	0.0189	0.0200
	N	20,069	20,069	20,069	20,069
Trading Volume	Mean	660.7228	701.9711	718.6794	738.6245
	Median	35	41.5	35	41.5
	Max	14,581.1	14,581.1	103,485.3	41,134.3
	Min	0.1	0.1	0	0
	StdDev	1,980.130	2,061.285	2,646.311	2,365.057
	StdErr	14.5023	14.7612	19.3813	16.9365
	N	18,643	19,500	18,643	19,500
Trading Turnover	Mean	0.3003	0.3401	0.3033	0.3427
	Median	0.1009	0.1131	0.1009	0.1131
	Max	30.1486	24.1186	30.1486	24.1186
	Min	0	0	0	0
	StdDev	0.6768	0.6918	0.6865	0.7046
	StdErr	0.0050	0.0050	0.0050	0.0050
	N	18,643	19,500	18,643	19,500
High-Low Spread	Mean	3.8426	5.6401	3.8723	5.6835
	Median	3.1655	4.9661	3.2129	4.9383
	Max	114.2509	50.0337	114.2509	50.0337
	Min	0	0	0	0
	StdDev	3.3500	4.0265	3.3873	4.1227
	StdErr	0.0245	0.0288	0.0248	0.0295
	N	18,643	19,508	18,643	19,508
Standard Deviation (5-day)	Mean	0.4000	0.5668	0.4098	0.5811
	Median	0.3051	0.4564	0.3124	0.4672
	Max	8.1791	6.5519	8.1791	6.5519
	Min	0	0	0	0
	StdDev	0.3688	0.4389	0.3700	0.4373
	StdErr	0.0026	0.0031	0.0026	0.0031
	N	20,070	20,070	20,070	20,070
Standard Deviation (10-day)	Mean	0.3949	0.5508	0.4044	0.5639
	Median	0.2966	0.4325	0.3030	0.4439
	Max	6.0006	4.6975	6.0006	4.6975
	Min	0	0	0	0
	StdDev	0.3580	0.4305	0.3598	0.4286
	StdErr	0.0025	0.0030	0.0025	0.0030
	N	20,070	20,070	20,070	20,070

Table XI. Descriptive Statistics for Control Stocks

The table presents descriptive statistics for the variables in the study before and after the reform for the control stocks. The statistics is shown for both the winsorized and unwinsorized data.

		Winsorized		Unwinsorized	
Parameter	**Descriptive statistic**	**Before**	**After**	**Before**	**After**
Absolute Bid-Ask Spread	Mean	1.2886	1.2076	1.3085	1.2390
	Median	0.4726	0.4239	0.4726	0.4239
	Max	48.686	78.823	53.501	78.823
	Min	0	0	0	0
	StdDev	2.4546	2.5495	2.7255	2.7596
	StdErr	0.0241	0.0251	0.0268	0.0271
	N	10,340	10,344	10,340	10,344
Relative Bid-Ask Spread	Mean	2.5778	3.1153	2.7110	3.3482
	Median	1.3981	1.6173	1.4159	1.6260
	Max	65.5462	192.4550	65.5462	199.0361
	Min	0	0	0	0
	StdDev	3.6850	5.0411	3.9832	5.6244
	StdErr	0.0362	0.0496	0.0392	0.0553
	N	10,340	10,344	10,340	10,344
Trading Volume	Mean	539.6920	552.3873	677.7219	681.7361
	Median	16.2	21.85	16.2	21.85
	Max	14,581.1	14,581.1	103,352.3	93,769.1
	Min	0.1	0.1	0	0
	StdDev	1,786.6610	1,800.6700	3,343.2480	3,203.6290
	StdErr	18.3211	18.2981	34.2830	32.5548
	N	9,510	9,684	9,510	9,684
Trading Turnover	Mean	0.2632	0.2878	0.2685	0.2945
	Median	0.0506	0.0636	0.0506	0.0636
	Max	8.5288	15.6192	14.1391	19.2012
	Min	0	0	0	0
	StdDev	0.5801	0.7038	0.6086	0.7551
	StdErr	0.0059	0.0072	0.0062	0.0077
	N	9,510	9,684	9,510	9,684
High-Low Spread	Mean	3.8052	4.8273	3.8759	4.9926
	Median	3.1746	4.0268	3.1796	4.0166
	Max	40.0	43.5	40.0	66.7
	Min	0	0	0	0
	StdDev	3.3640	4.4059	3.6265	4.9551
	StdErr	0.0345	0.0448	0.0372	0.0504
	N	9,510	9,683	9,510	9,683
Standard Deviation (5-day)	Mean	0.3552	0.4796	0.3652	0.4973
	Median	0.2761	0.3808	0.2800	0.3868
	Max	3.8130	4.5555	3.8130	4.8433
	Min	0	0	0.0039	0.0207
	StdDev	0.3060	0.3739	0.3131	0.3988
	StdErr	0.0030	0.0037	0.0031	0.0039
	N	10,350	10,350	10,350	10,350
Standard Deviation (10-day)	Mean	0.3295	0.4481	0.3384	0.4610
	Median	0.2443	0.3476	0.2490	0.3537
	Max	2.7382	3.4625	2.7382	3.5228
	Min	0	0	0.0085	0.0283
	StdDev	0.2843	0.3482	0.2888	0.3589
	StdErr	0.0028	0.0034	0.0028	0.0035
	N	10,350	10,350	10,350	10,350

Table XII. Treated Stocks

The table presents the stocks included in the treated stocks. The small cap listing requires a market capitalization of less than 150 MEUR, the mid cap listing requires a market capitalization of between 150 MEUR and 1 billion euros and the large cap listing requires a market capitalization of above 1 billion euros.

Large Cap Stocks
ABB Ltd
ASSA ABLOY AB ser. B
AstraZeneca PLC
Atlas Copco AB ser. B
Axfood AB
Boliden AB
Castellum AB
Electrolux, AB ser. B
Elekta AB ser. B
Fabege AB
Getinge AB ser. B
Hennes & Mauritz AB, H & M ser. B
Hexagon AB ser. B
Holmen AB ser. B
Hufvudstaden AB ser. A
Husqvarna AB ser. B
Industrivärden, AB ser. C
Investor AB ser. B
Kinnevik, Investment AB ser. B
Latour, Investmentab. ser. B
Lindab International AB
Lundbergföretagen AB, L E ser. B
Lundin Petroleum AB
Meda AB ser. A
Melker Schörling AB
Millicom International Cellular S.A. SDB
Modern Times Group MTG AB ser. B
Nordea Bank AB
Oriflame Cosmetics S.A, SDB
PA Resources AB
Ratos AB ser. B
SAAB AB ser. B
Sandvik AB
Seco Tools AB ser. B
Securitas AB ser. B
Skanska AB ser. B
SSAB AB ser. B
Svedbergs i Dalstorp AB ser. B
Svenska Cellulosa AB SCA ser. B
Swedish Match AB
Tele2 AB ser. B
TeliaSonera AB
Trelleborg AB ser. B
Volvo AB ser. B

Mid Cap Stocks
AarhusKarlshamn AB
Active Biotech AB
Addtech AB ser. B

Mid Cap Stocks
Alliance Oil Company Ltd. SDB
Atrium Ljungberg AB ser. B
Autoliv Inc. SDB
Avanza Bank Holding AB
Axis AB
B&B TOOLS AB ser. B
BE Group AB
Beijer AB, G & L ser. B
Beijer Alma AB ser. B
Billerud AB
BioInvent International AB
Björn Borg AB
Brinova Fastigheter AB ser.B
Bure Equity AB
Cardo AB
Cision AB
Clas Ohlson AB ser. B
Duni AB
East Capital Explorer AB
Eniro AB
Fagerhult, AB
Fast Partner AB
Gunnebo AB
Hakon Invest AB
Haldex AB
Hemtex AB
HQ AB
Industrial & Financial Systems AB ser. B
Indutrade AB
Intrum Justitia AB
JM AB
Klövern AB
Kungsleden AB
LBI International AB
Lundin Mining Corporation SDB
Mekonomen AB
Metro International S.A SDB ser. B
Munters AB
NCC AB ser. B
Net Insight AB ser. B
New Wave Group AB ser. B
NIBE Industrier AB ser. B
Niscayah Group AB
Nobia AB
Nordnet AB ser. B
Orc Group AB
Peab AB ser. B
Q-Med
Rezidor Hotel Group AB

Mid Cap Stocks
RNB RETAIL AND BRANDS AB
SäkI AB
SAS AB
SECTRA AB ser B
Skandinaviska Enskilda Banken ser. C
Skanditek AB
SkiStar AB ser. B
Stora Enso Oyj ser. R
Svenska Handelsbanken ser. B
SWECO AB ser. B
Swedish Orphan Biovitrum AB
Systemair AB
TradeDoubler AB
Unibet Group Plc
VBG GROUP AB ser. B
Vostok Nafta Investment Ltd, SDB
Wallenstam AB ser. B
Wihlborgs Fastigheter AB
ÅF AB ser. B
Öresund, Investment AB

Small Cap Stocks
AcadeMedia AB
Acando AB ser. B
ACAP Invest AB ser. B
A-Com AB
AddNode AB ser. B
Aerocrine AB ser. B
Affärsstrategerna AB
Allenex AB
Anoto Group AB
Artimplant AB ser. B
Aspiro AB
Beijer Electronics AB
Bergs Timber AB ser. B
Bilia AB ser. A
BioGaia AB ser. B
Biolin Scientific AB
BioPhausia AB
Biotage AB
Bong Ljungdahl AB
Borås Wäfveri AB
BTS Group AB ser. B
Catena AB
Concordia Maritime AB ser. B
Connecta AB
Consilium AB ser. B
CTT Systems AB
Cybercom Group AB

Small Cap Stocks
Dagon AB
Diamyd Medical AB ser. B
Din Bostad Sverige AB
Diös Fastigheter AB
DORO AB
Duroc AB ser. B
Elanders AB ser. B
ElektronikGruppen BK Aktiebolag
Elos AB ser. B
EpiCept Corporation
Fastighets AB Balder ser. B
Feelgood Svenska AB
Fenix Outdoor AB ser. B
Fingerprint Cards AB ser. B
Geveko, AB ser. B
Havsfrun Investment AB ser. B
HMS Networks AB
I.A.R Systems Group AB ser. B
Image Systems AB
Intellecta AB ser. B
Jeeves Information Systems AB
KABE AB ser. B
Karo Bio AB
Know IT AB
Lagercrantz Group AB ser B
Lammhults Design Group AB ser. B
Ledstiernan AB
Luxonen S.A. SDB
Malmbergs Elektriska AB ser. B
Medivir AB ser. B
Micronic Mydata AB
Midsona AB ser. B
Midway Holding AB ser. B
Modul 1 Data AB
MSC Konsult AB ser. B
MultiQ International AB
Nederman Holding AB
Netonnet AB
Nolato AB ser. B
NOTE AB
NovaCast Technologies AB
Novestra AB
NOVOTEK AB ser. B
OEM International AB ser. B
Opcon AB
Orexo AB
Ortivus AB ser. B
Oxigene Inc
PartnerTech AB

Small Cap Stocks
Poolia AB ser. B
Precise Biometrics AB
Prevas AB ser. B
Pricer AB ser. B
Proact IT Group AB
Probi AB
Proffice AB ser. B
ProfilGruppen AB ser. B
ReadSoft AB ser. B
Rederi AB Transatlantic ser. B
Rejlerkoncernen AB
Rörvik Timber AB ser. B
Rottneros AB
Sagax AB pref
Semcon AB
Sensys Traffic AB
Sigma AB ser. B
SinterCast AB
Softronic AB ser. B
StjärnaFyrkant AB
Studsvik AB
Svolder AB ser. B
Swedbank AB ser. A
Technology Nexus AB
Ticket Travel Group AB
Traction AB ser. B
Transcom WorldWide S.A SDB ser. B
Tricorona AB
Uniflex AB ser. B
Venue Retail Group AB ser. B
Vitrolife AB
XANO Industri AB ser. B

Table VIII. Control Stocks

The table presents the stocks included in the control stocks. The small cap listing requires a market capitalization of less than 150 MEUR, the mid cap listing requires a market capitalization of between 150 MEUR and 1 billion euros and the large cap listing requires a market capitalization of above 1 billion euros.

Large Cap Stocks
Cargotec Oyj
Elisa Oyj
Fortum Oyj
Kemira Oyj
Kesko Oyj B
KONE Oyj
Konecranes Oyj
Metso Oyj
Neste Oil Oyj
Nokia Oyj
Nokian Renkaat Oyj
Nordea Bank AB (publ) FDR
Orion Oyj B
Outokumpu Oyj
Outotec Oyj
Rautaruukki Oyj K
Sampo Oyj A
Sanoma Oyj
Stora Enso Oyj R
Tieto Oyj
UPM-Kymmene Oyj
Uponor Oyj
Wärtsilä Oyj Abp
YIT Oyj

Mid Cap Stocks
Ahlstrom Oyj
Alma Media Oyj
Amer Sports Corporation
Aspo Oyj
Atria Oyj A
CapMan Oyj B
Citycon Oyj
Comptel Oyj
Cramo Oyj
Elektrobit Oyj
Finnair Oyj
Finnlines Oyj
Fiskars Oyj
F-Secure Oyj
Glaston Corporation
HKScan Oyj A
Huhtamäki Oyj
Lassila &Tikanoja Oyj
Lemminkäinen Oyj
Olvi Oyj A
Oriola-KD Oyj B
Pohjois-Karjalan Kirjapaino Oyj
Ponsse Oyj 1

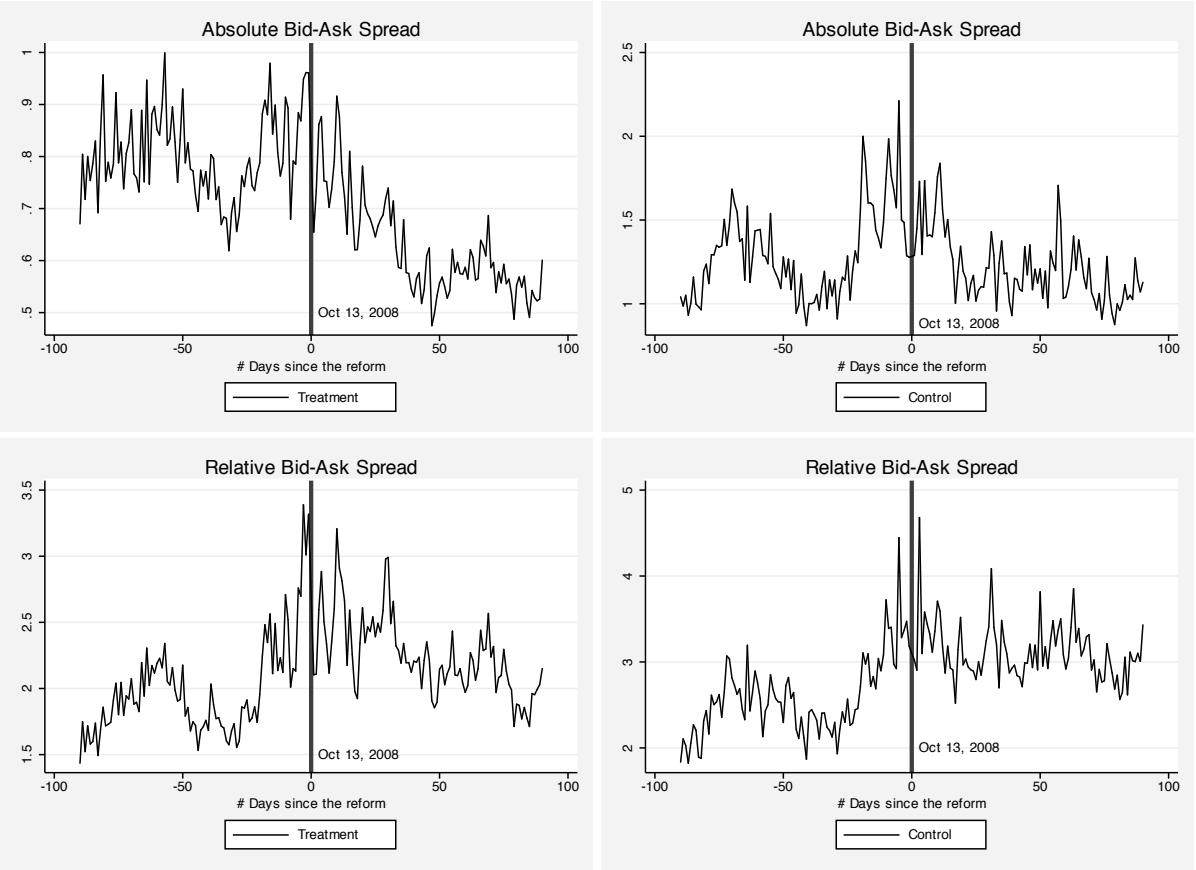
Mid Cap Stocks
Pöyry Oyj
Raisio Oyj Vaihto-osake
Ramirent Oyj
Rapala VMC Oyj
Ruukki Group Oyj
Sponda Oyj
SRV Group plc
Stockmann Oyj Abp B
Technopolis Oyj
Tekla Oyj
Vacon Oyj
Vaisala Oyj A
Viking Line Abp
Ålandsbanken Abp B

Small Cap Stocks
Affecto Oyj
Aldata Solution Oyj
Aspocomp Group Oyj
Basware Oyj
Biohit Oyj B
Biotie Therapies Oyj
Cencorp Oyj
Componenta Oyj
Digia Plc
Dovre Group Oyj
Efore Oyj
Elcoteq SE
Elecster Oyj A
eQ Oyj
Etteplan Oyj
Exel Composites Oyj
GeoSentric Plc
Honkarakenne Oyj B
Ilkka-Yhtymä Oyj 2
Incap Oyj
Innofactor Plc
Interavanti Oyj
Ixonos Oyj
Julius Tallberg-Kiinteistöt Oyj
Keskisuomalainen Oyj A
Kesla Oyj A
Lännen Tehtaat Oyj
Marimekko Oyj
Martela Oyj A
Metsä Board Oyj
Neo Industrial Oyj
Nordic Aluminium Oyj
Norvestia Oyj

Small Cap Stocks
Nurminen Logistics Oyj
Okmetic Oyj
Oral Hammaslääkärit Oyj
Panostaja Oyj
PKC Group Oyj
QPR Software Oyj
Raute Oyj A
Saga Furs Oyj
Salcomp Oyj
Solteq Oyj
SSK S.Säästäjien Kiinteistöt Oyj
Stonesoft Oyj
Suominen Oyj
Takoma Oyj
Talentum Oyj
Tamfelt Oyj
Tectia Oyj
Teleste Oyj
Tiimari Oyj Abp
Trainers´ House Oyj
Tulikivi Oyj A
Turvatiimi Oyj
Vaahto Group Plc Oyj
Wulff-Yhtiöt Oy
Yleiselektroniikka Oyj E

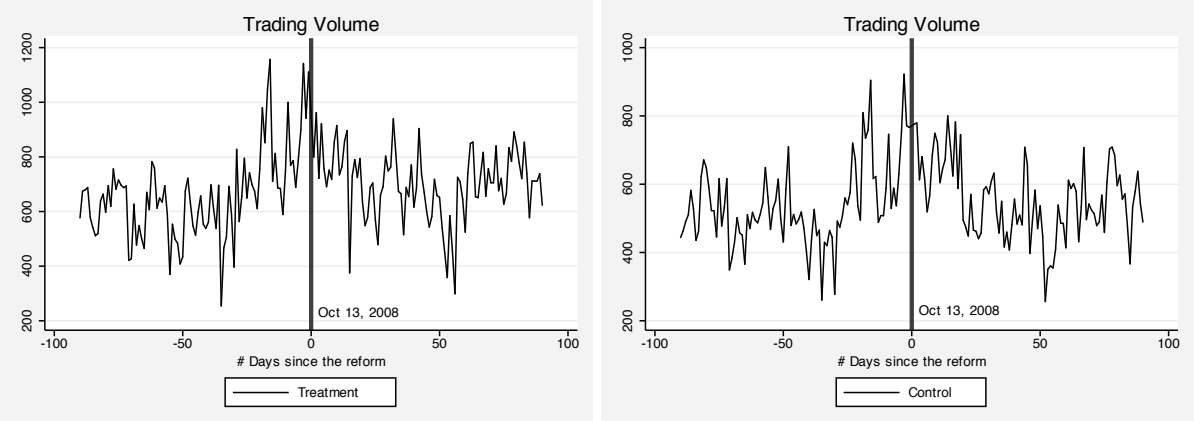
Graphs I-IV. Absolute Bid-Ask Spread and Relative Bid-Ask Spread

Graphs I-IV illustrate the absolute and relative bid-ask spread over a time period of 180 trading days, equally divided around the reform date. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two. For the absolute bid-ask spread, the y-axis shows the spread expressed in SEK and the x-axis shows the number of days relative to the reform. For the relative bid-ask spread, the y-axis shows the spread expressed in percentage points and the x-axis shows the number of days relative to the reform.



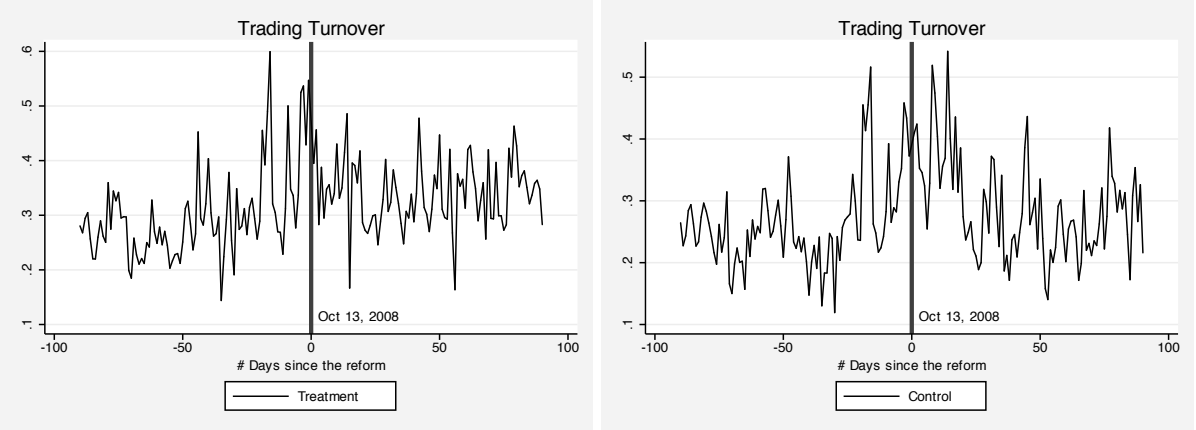
Graphs V-VI. Trading Volume

Graphs V-VI illustrate the daily trading volume over a time period of 180 trading days, equally divided around the reform date. The daily trading volume is defined as the aggregate number of traded shares during a trading day. The y-axis shows the number of shares traded expressed in millions of shares and the x-axis shows the number of days relative to the reform.



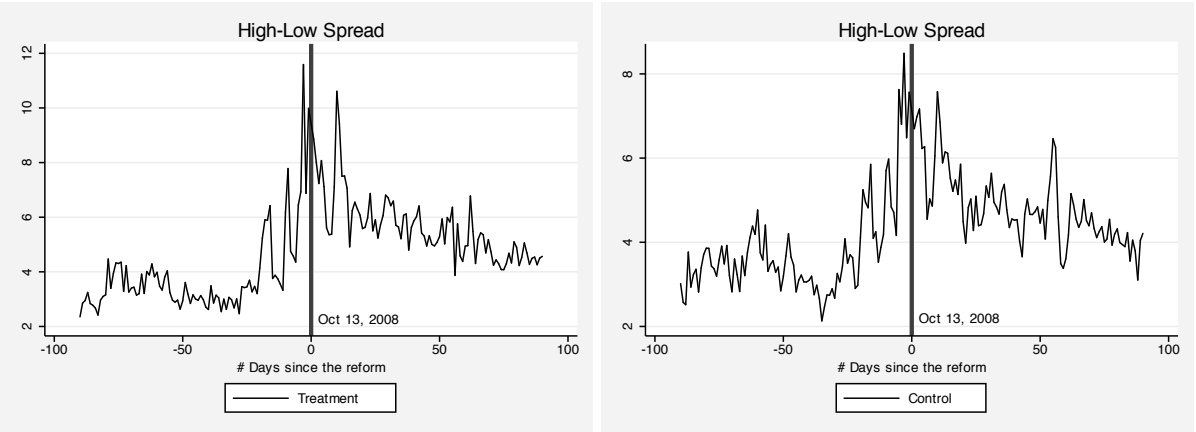
Graphs VII-VIII. Trading Turnover

Graphs VII-VIII illustrate the daily trading turnover over a time period of 180 trading days, equally divided around the reform date. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding. The y-axis shows the turnover expressed in percentage points and the x-axis shows the number of days relative to the reform.



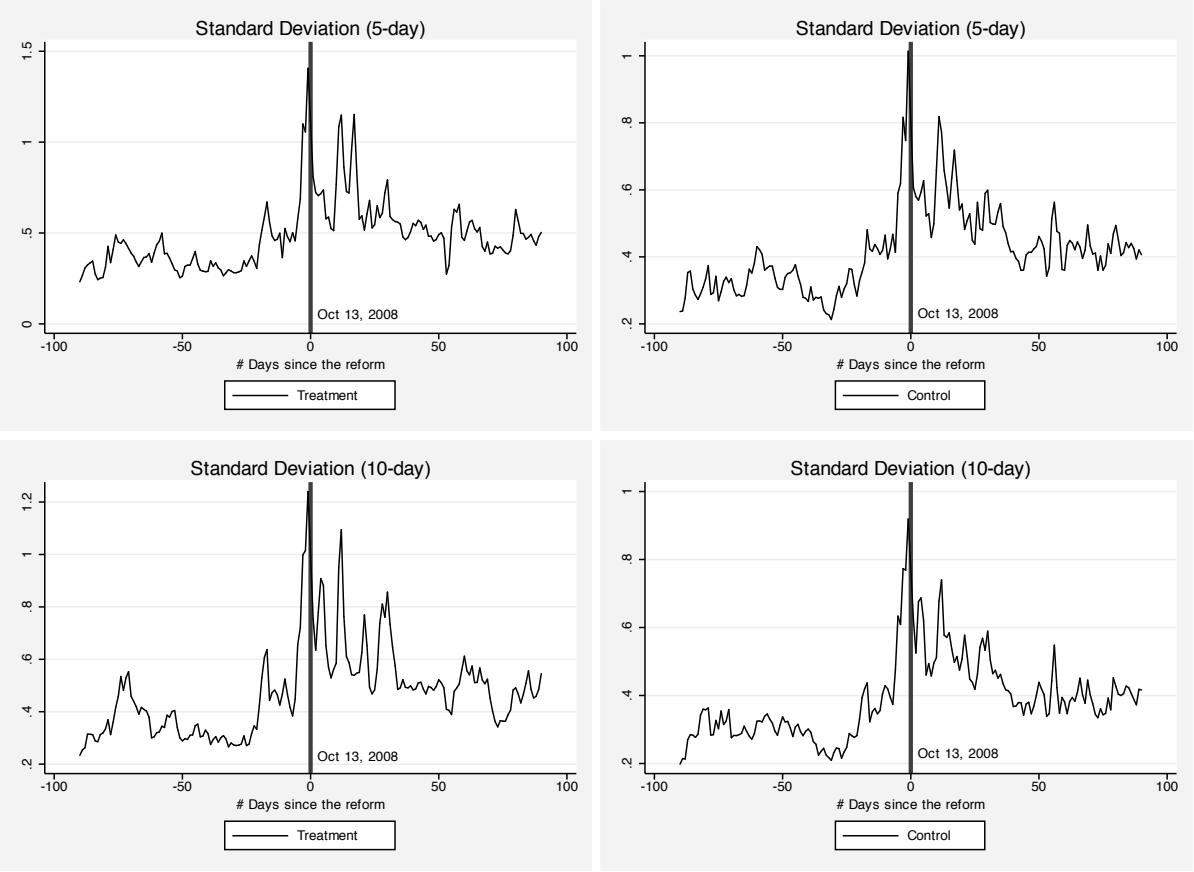
Graphs IX-X. High-Low Spread

Graphs IX-X illustrate the daily high-low spread over a time period of 180 trading days, equally divided around the reform date. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two. The y-axis shows the spread expressed in percentage points and the x-axis shows the number of days relative to the reform.



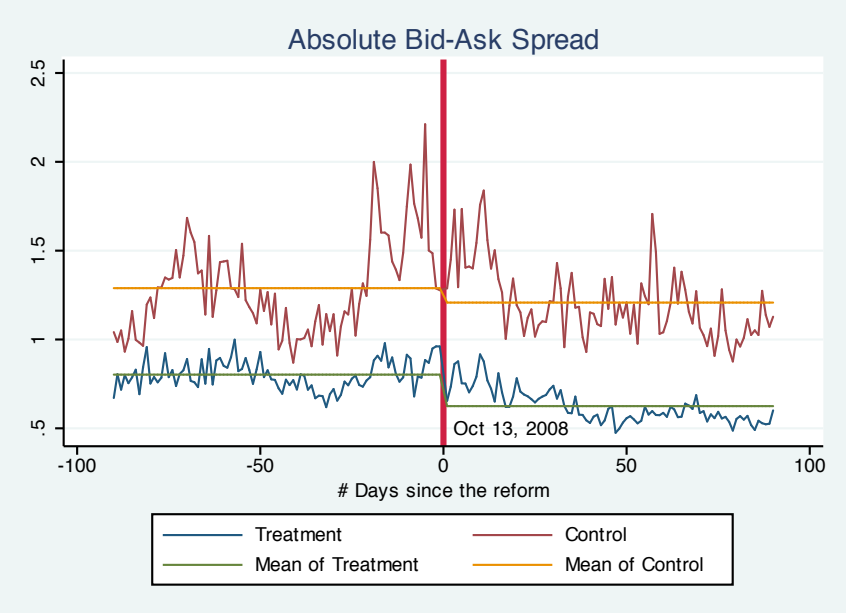
Graphs XI-XIV. Standard Deviation (5-day and 10-day)

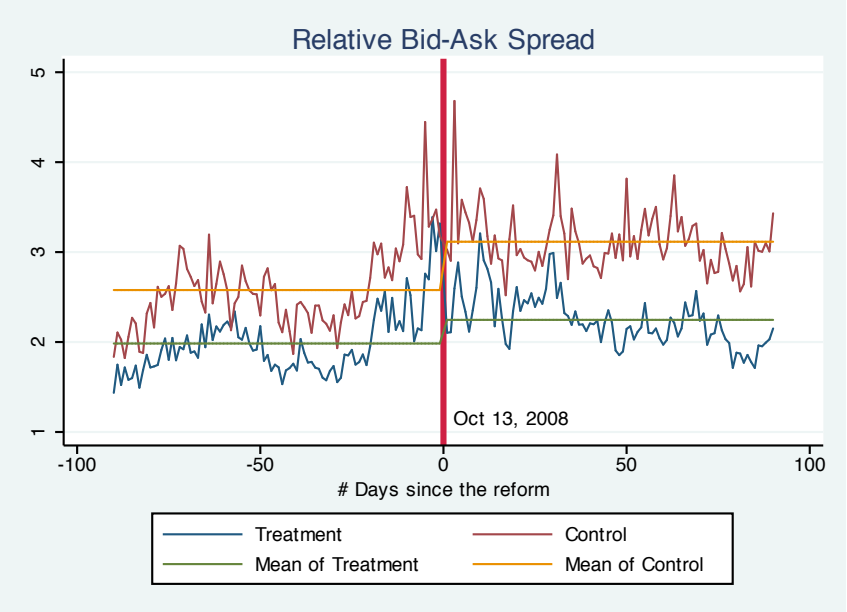
Graphs XI-XIV illustrate the 5-day and 10-day standard deviation over a time period of 180 trading days, equally divided around the reform date. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages. The y-axis shows the standard deviation expressed in percentage points and the x-axis shows the number of days relative to the reform.

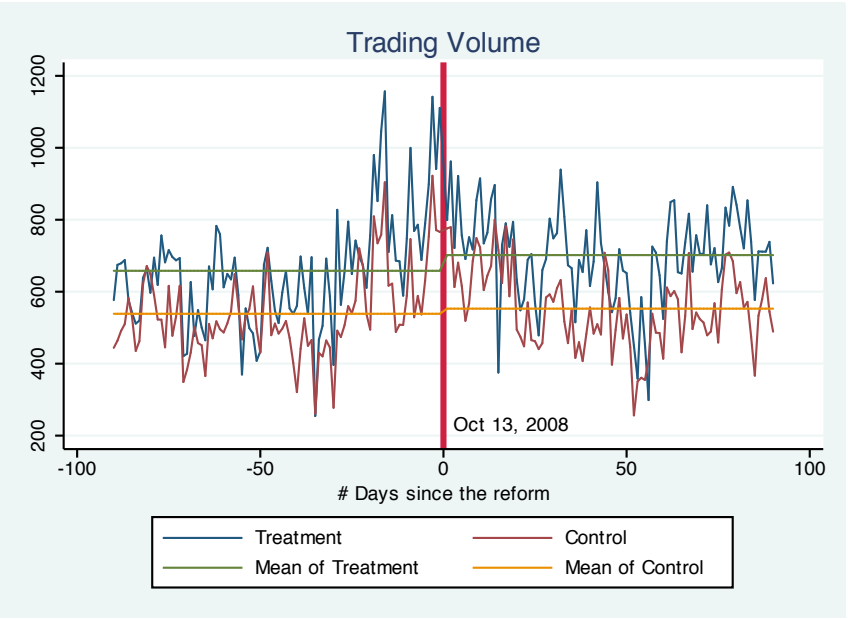


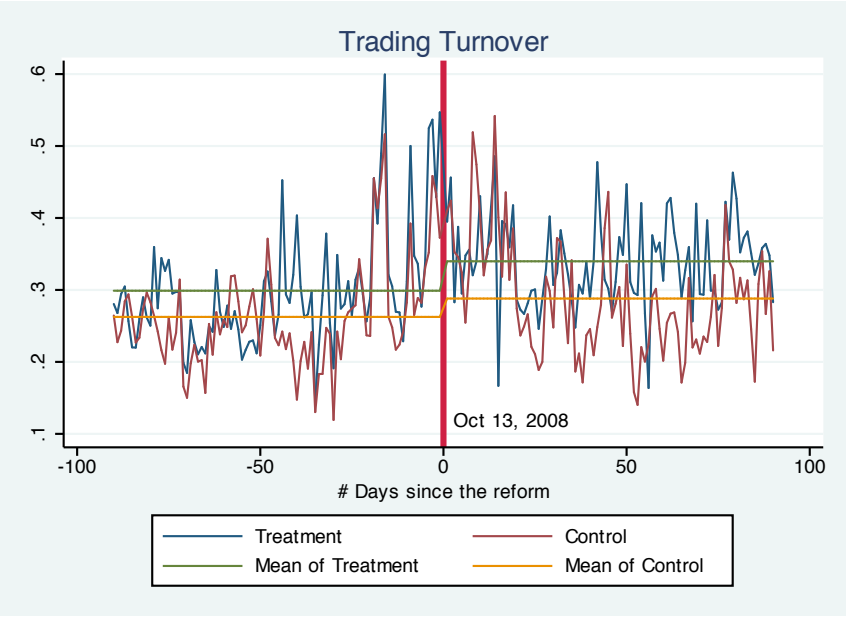
Graphs XV-XVIII. Difference-in-Differences Estimation: Liquidity Measures

Graphs XV-XVIII illustrate the liquidity measures and the mean of these as explained by the difference-in-differences estimations over a time period of 180 trading days, equally divided around the reform date. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two. The daily trading volume is defined as the aggregate number of traded shares during a trading day. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding. For the absolute bid-ask spread, the y-axis shows the spread expressed in SEK and the x-axis shows the number of days relative to the reform. For the relative bid-ask spread, the y-axis shows the spread expressed in percentage points and the x-axis shows the number of days relative to the reform. For the trading volume, the y-axis shows the number of shares traded expressed in millions of shares and the x-axis shows the number of days relative to the reform. For the trading turnover, the y-axis shows the turnover expressed in percentage points and the x-axis shows the number of days relative to the reform.



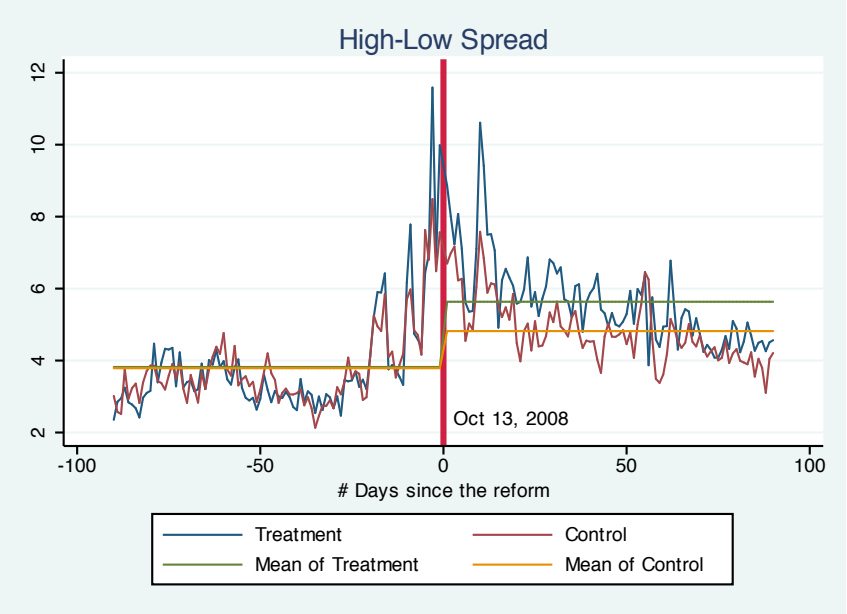


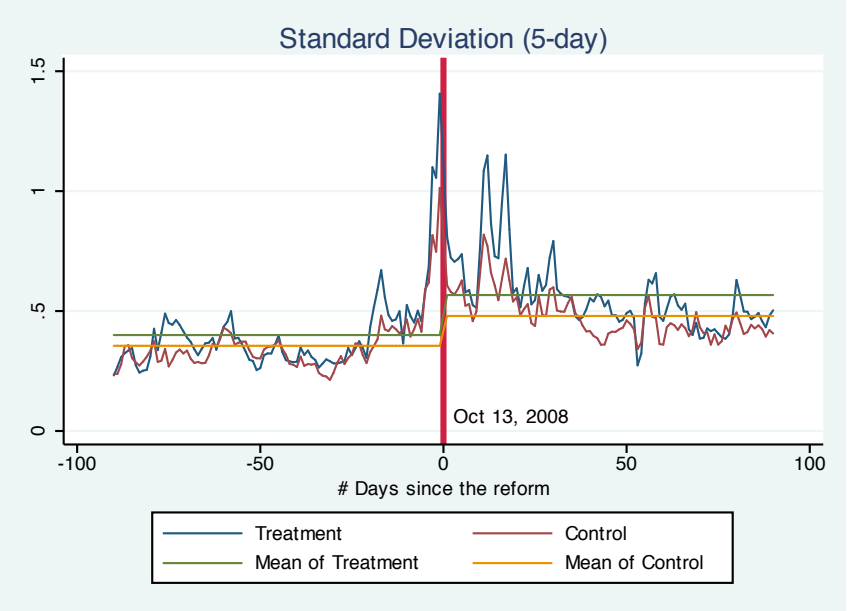

Trading Volume
200
400
600
800
1000
1200
-100
-50
0
50
100
Oct 13, 2008
Days since the reform
Treatment
Control
Mean of Treatment
Mean of Control


Trading Turnover
.1
.2
.3
.4
.5
.6
-100
-50
0
50
100
Oct 13, 2008
Days since the reform
Treatment
Control
Mean of Treatment
Mean of Control

Graphs XIX-XXI. Difference-in-Differences Estimation: Volatility Measures

Graphs XIX-XXI illustrate the volatility measures and the mean of these as explained by the difference-in-differences estimations over a time period of 180 trading days, equally divided around the reform date. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages. For the high-low spread, the y-axis shows the spread expressed in percentage points and the x-axis shows the number of days relative to the reform. For the standard deviation, the y-axis shows the standard deviation expressed in percentage points and the x-axis shows the number of days relative to the reform.





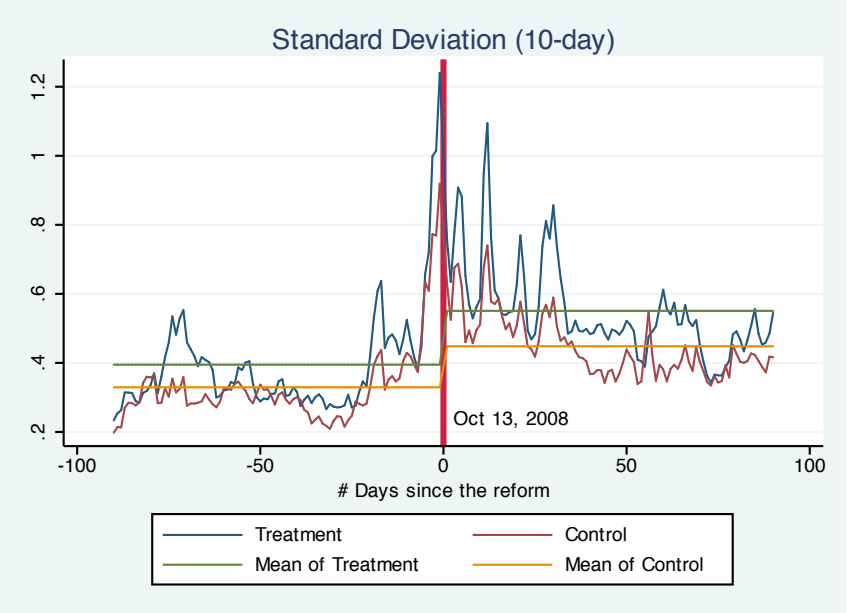

Standard Deviation (10-day)
.2
.4
.6
.8
1
1.2
-100
-50
0
50
100
Oct 13, 2008
Days since the reform
Treatment
Control
Mean of Treatment
Mean of Control

Table XIV. Complete Results of Difference-in-Differences Estimations

The tables present the complete results of the difference-in-differences estimations. The event window is set to a time period of 180 trading days, equally divided around the reform date. The difference-in-difference estimator is given by Treated×Post, the time trend estimator is given by Post, the country specific estimator is given by Treated and the constant is given by Constant. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

Absolute Bid-Ask Spread	Coefficient	Robust Standard Errors	t-stat	Prob > |Z|	95% Confidence Interval	
Treated×Post	-0.0965	0.0609	-1.59	0.114	-0.2162	0.0232
Post	-0.0809	0.0533	-1.52	0.13	-0.1857	0.0239
Treated	(omitted)					
Constant	0.9676	0.0133	72.89	0	0.9415	0.9937
N	60,822					
R^2	0.0041					

Relative Bid-Ask Spread	Coefficient	Robust Standard Errors	t-stat	Prob > |Z|	95% Confidence Interval	
Treated×Post	-0.2746	0.1389	-1.98	0.049	-0.5478	-0.0013
Post	0.5372	0.1288	4.17	0	0.2839	0.7905
§	(omitted)					
Constant	2.1858	0.0278	78.49	0	2.1310	2.2406
N	60,822					
R^2	0.007					

Trading Volume	Coefficient	Robust Standard Errors	t-stat	Prob > |Z|	95% Confidence Interval	
Treated×Post	48.8492	27.1717	1.8	0.073	-4.5983	102.2968
Post	22.4527	15.3074	1.47	0.143	-7.6573	52.5627
Treated	(omitted)					
Constant	608.3378	8.0609	75.47	0	592.4818	624.1937
N	57,337					
R^2	0.002					

Trading Turnover	Coefficient	Robust Standard Errors	t-stat	Prob > |Z|	95% Confidence Interval	
Treated×Post	0.0201	0.0187	1.08	0.283	-0.0166	0.0568
Post	0.0288	0.0117	2.46	0.014	0.0058	0.0518
Treated	(omitted)					
Constant	0.2841	0.0053	53.38	0	0.2737	0.2946
N	57,337					
R^2	0.002					

High-Low Spread	Coefficient	Robust Standard Errors	t-stat	Prob > |Z|	95% Confidence Interval	
Treated×Post	0.8083	0.1471	5.5	0	0.5191	1.0976
Post	1.0405	0.1196	8.7	0	0.8053	1.2757
Treated	(omitted)					
Constant	3.8096	0.0354	107.51	0	3.7399	3.8793
N	57,344					
R^2	0.055					

Standard Deviation (5-day)	Coefficient	Robust Standard Errors	t-stat	Prob > |Z|	95% Confidence Interval	
Treated×Post	0.0424	0.0155	2.73	0.007	0.0119	0.0729
Post	0.1244	0.0116	10.68	0	0.1015	0.1473
Treated	(omitted)					
Constant	0.3848	0.0039	98.16	0	0.3771	0.3925
N	60,840					
R^2	0.045					

Standard Deviation (10-day)	Coefficient	Robust Standard Errors	t-stat	Prob > |Z|	95% Confidence Interval	
Treated×Post	0.0371	0.0168	2.22	0.027	0.0042	0.0701
Post	0.1187	0.0125	9.47	0	0.0940	0.1434
Treated	(omitted)					
Constant	0.3727	0.0042	87.85	0	0.3643	0.3810
N	60,840					
R^2	0.044					

Table XV. Difference-in-Differences Estimations: Using Frankfurt Stock Exchange as Control Group

The tables present the complete results of the difference-in-differences estimations when using stocks listed on the Frankfurt Stock Exchange as a control group. The event window is set to a time period of 180 trading days, equally divided around the reform date. The difference-in-difference estimator is given by $Treated \times Post$, the time trend estimator is given by $Post$, the country specific estimator is given by $Treated$ and the constant is given by $Constant$. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	-0.751***	-4.5272***	37.2425***	-1.2679	0.9636***	0.03	0.0227
	[0.2676]	[0.7157]	[13.6829]	[1.2829]	[0.1138]	[0.0639]	[0.0446]
Post	0.6053**	4.8001***	8.6362***	1.3119	0.8997***	0.1413**	0.1368***
	[0.2667]	[0.7138]	[3.1478]	[1.2828]	[0.0718]	[0.0633]	[0.0434]
Treated	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Constant	1.3216***	5.6235***	165.4248***	1.417***	3.144***	1.1374***	0.9113***
	[0.0673]	[0.1799]	[2.398]	[0.4254]	[0.0297]	[0.0245]	[0.0168]
N	82,106	82,106	120,275	120,275	174,993	177,292	177,277
R^2	0.001	0.044	0.003	0	0.012	0.002	0.004

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

Table XVI. Difference-in-Differences Estimations: Event Window of 200 days

The tables present the results of the difference-in-differences estimations using an extended event window of 200 days, equally divided around the reform date. The difference-in-difference estimator is given by Treated×Post, the time trend estimator is given by Post, the country specific estimator is given by Treated and the constant is given by Constant. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	-0.127**	-0.3201**	53.5025*	0.0186	0.7628***	0.0386**	0.0403**
	[0.0596]	[0.1408]	[27.7644]	[0.0182]	[0.1475]	[0.0151]	[0.0161]
Post	-0.0429	0.6429***	30.6961**	0.0308***	1.1357***	0.1304***	0.1221***
	[0.0518]	[0.1321]	[14.3352]	[0.0116]	[0.1202]	[0.0112]	[0.0118]
Treated	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Constant	0.9471***	2.1148***	597.5084***	0.2814***	3.6631***	0.3689***	0.3577***
	[0.0131]	[0.0277]	[8.4343]	[0.0051]	[0.0354]	[0.0039]	[0.0042]
N	67,581	67,581	63,697	63,697	63,703	67,600	67,600
R^2	0.004	0.010	0.003	0.002	0.061	0.049	0.049

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

Table XVII. Difference-in-Differences Estimations: Event Window of 160 days

The tables present the results of the difference-in-differences estimations using a shortened event window of 160 days, equally divided around the reform date. The difference-in-difference estimator is given by Treated×Post, the time trend estimator is given by Post, the country specific estimator is given by Treated and the constant is given by Constant. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	-0.072	-0.2282	40.2158	0.0137	0.7859***	0.0385**	0.0339*
	[0.0632]	[0.1389]	[27.5297]	[0.0189]	[0.1466]	[0.0159]	[0.0174]
Post	-0.097*	0.4899***	22.7511	0.0297**	1.0751***	0.1237***	0.1169***
	[0.0563]	[0.1285]	[15.445]	[0.0117]	[0.1177]	[0.012]	[0.0129]
Treated	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Constant	0.9799***	2.2372***	613.3892***	0.2871***	3.9224***	0.397***	0.3837***
	[0.0135]	[0.0279]	[8.1781]	[0.0054]	[0.0357]	[0.004]	[0.0044]
N	54,062	54,062	50,993	50,993	51,000	54,080	54,080
R^2	0.004	0.006	0.001	0.001	0.054	0.042	0.040

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

Table XVIII. Difference-in-Differences Estimations: Excluding Stocks with Missing Observations

The tables present the complete results of the difference-in-differences estimations. The event window is set to a time period of 180 trading days, equally divided around the reform date. The estimations include only stocks with non-missing observations. The difference-in-difference estimator is given by Treated×Post, the time trend estimator is given by Post, the country specific estimator is given by Treated and the constant is given by Constant. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	-0.0137	-0.0237	80.3413*	0.0508*	0.9306***	0.0709***	0.0676***
	[0.0565]	[0.0579]	[46.2035]	[0.0279]	[0.1434]	[0.019]	[0.0208]
Post	-0.1374***	0.1612***	31.274	0.0173	0.887***	0.1023***	0.0917***
	[0.0411]	[0.0501]	[29.271]	[0.0188]	[0.1042]	[0.0126]	[0.0138]
Treated	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Constant	0.6049***	0.9785***	1000***	0.4257***	4.409***	0.4214***	0.4151***
	[0.0149]	[0.0126]	[13.312]	[0.0078]	[0.0379]	[0.0053]	[0.0059]
N	33,480	33,480	33,480	33,480	33,480	33,480	33,480
R^2	0.016	0.006	0.003	0.003	0.067	0.043	0.038

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

Table XIX. Difference-in-Differences Estimations: Using Subgroups Based on Market Capitalization

The tables present the results of the difference-in-differences estimations subgroups based on market capitalizations sorted according to the Nasdaq Omx market capitalization listing. The event window is set to a time period of 180 trading days, equally divided around the reform date. The small listing requires a market capitalization of less than 150 MEUR, the mid listing requires between 150 MEUR and 1 billion euros and the large listing requires a market capitalization of above 1 billion euros. An observation equals value 1 if the observation belongs to the subgroup. The difference-in-difference estimator is given by Treated×Post, the time trend estimator is given by Post, the country specific estimator is given by Treated and the constant is given by Constant. N corresponds to the number of observations in each event period. R^2 corresponds to the fit of the regression. The estimations control for fixed effects through fixed effects regressions and serial correlation by including clustered standard errors on stock level. The absolute bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price and expressed in SEK. The relative bid-ask spread is defined as the difference between the quoted highest bid price and the quoted lowest ask price divided by the midpoint of the two and expressed in percentage points. The daily trading volume is defined as the aggregate number of traded shares during a trading day and expressed in millions of shares. The daily trading turnover is defined as the aggregate number of traded shares during a trading day divided by the total number of shares outstanding and expressed in percentage points. The high-low spread is defined as the difference between the daily highest trading price and the daily lowest trading price divided by the midpoint of the two and expressed in percentage points. The 5-day and 10-day standard deviation is defined as the standard deviation in daily logarithmic returns over 5-day and 10-day averages and expressed in percentage points.

Small Cap	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	-0.1716**	-0.5228*	-1.3466	-0.0208	0.6631**	0.0093	-0.0007
	[0.071]	[0.2711]	[11.1174]	[0.0232]	[0.2744]	[0.0248]	[0.0275]
Post	-0.006	0.902***	21.2989***	0.05***	1.2625***	0.1438***	0.1463***
	[0.0624]	[0.2523]	[7.3086]	[0.0146]	[0.2304]	[0.0188]	[0.0207]
Treated	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Constant	1.0524***	3.431***	55.6756***	0.1345***	3.3796***	0.3617***	0.3466***
	[0.0153]	[0.0534]	[3.1943]	[0.0068]	[0.0649]	[0.0063]	[0.0069]
N	29,144	29,144	26,007	26,007	26,015	29,160	29,160
R^2	0.003	0.010	0.002	0.002	0.048	0.043	0.046

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

Mid Cap	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	0.0126	-0.1048	-3.137	0.0153	0.9671***	0.0503*	0.0427
	[0.1417]	[0.1326]	[39.2809]	[0.0331]	[0.2132]	[0.0263]	[0.0269]
Post	-0.1909	0.3187***	44.9865*	0.0362**	0.7704***	0.1151***	0.1118***
	[0.1298]	[0.1201]	[25.8439]	[0.0163]	[0.1621]	[0.0204]	[0.0197]
Treated	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Constant	1.117***	1.4446***	171.7338***	0.221***	4.1084***	0.4036***	0.3986***
	[0.0291]	[0.0277]	[10.7764]	[0.01]	[0.0537]	[0.0065]	[0.0069]
N	19,438	19,438	19,097	19,097	19,096	19,440	19,440
R^2	0.005	0.008	0.002	0.002	0.056	0.042	0.039

Standard error in brackets
*p<0.1, ** p<0.05, *** p<0.01

Large Cap	Absolute Bid-Ask Spread	Relative Bid-Ask Spread	Trading Volume	Trading Turnover	High-Low Spread	Standard Deviation (5-day)	Standard Deviation (10-day)
Treated×Post	-0.0957	0.0009	240.6124**	0.1113**	0.8437***	0.1076***	0.1158***
	[0.1071]	[0.0361]	[106.4154]	[0.0483]	[0.1626]	[0.0255]	[0.0259]
Post	-0.0796	0.0543**	-9.0225	-0.0235	1.0133***	0.095***	0.0673***
	[0.0669]	[0.0208]	[53.7565]	[0.034]	[0.1192]	[0.0167]	[0.0184]
Treated	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Constant	0.5285***	0.3979***	2466,8277***	0.7012***	4.2536***	0.4098***	0.3935***
	[0.0295]	[0.0102]	[31.2082]	[0.0126]	[0.0415]	[0.0069]	[0.0067]
N	12,240	12,240	12,233	12,233	12,233	12,240	12,240
R^2	0.021	0.005	0.005	0.005	0.092	0.063	0.052

Standard error in brackets

*p<0.1, ** p<0.05, *** p<0.01